California Regional Water Quality Control Board
San Diego Region

Total Maximum Daily Loads for Dissolved Copper, Lead, and Zinc in Chollas Creek, Tributary to San Diego Bay

Chollas Creek Watershed

Technical Report
March 25, 2005

Public Review Draft

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To request copies of the Basin Plan Amendment and Technical Report for Copper, Lead and Zinc Total Maximum Daily Loads for Chollas Creek please contact Jimmy Smith, Environmental Scientist at (858) 467-2732, jsmith@waterboards.ca.gov.

Documents also are available at: http://www.waterboards.ca.gov/sandiego.

TOTAL MAXIMUM DAILY LOADS FOR DISSOLVED COPPER, LEAD AND ZINC IN CHOLLAS CREEK, TRIBUTARY TO SAN DIEGO BAY

Technical Report

Adopted by the
California Regional Water Quality Control Board
San Diego Region
on ______________, 200x

Approved by the
State Water Resources Control Board
on _______________, 200 x
and the
Office of Administrative Law
on _______________,200 x
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EXECUTIVE SUMMARY

Chollas Creek[1] is an urban coastal stream in southern San Diego County, tributary to San Diego Bay. Chollas Creek was placed on the Clean Water Act (CWA) section 303(d) List of Water Quality Limited Segments (List of Water Quality Limited Segments) in 1996 for the metals copper, lead and zinc. Storm water samples from Chollas Creek collected between 1994 and 2003 periodically exceeded California Toxics Rule (CTR) water quality criteria for copper, lead and zinc. The existing and potential beneficial uses of Chollas Creek and San Diego Bay described in the Water Quality Control Plan for the San Diego Basin (9) (Basin Plan) are adversely affected by these exceedances. Additionally, these exceedances violate the narrative water quality objectives (WQOs) for toxicity described in the Basin Plan.

1. Problem Statement

While only the lowest 1.2 miles of Chollas Creek comprise the actual listed segment of the water body, all upstream tributaries to this section are considered in this TMDL project. The California Regional Water Quality Control Board, San Diego Region (Regional Board) has established Total Maximum Daily Loads (TMDLs) for copper, lead, and zinc as required by the CWA for water quality limited segments.

Chollas Creek is also listed as impaired for the metal cadmium. The available data suggest that concentrations of dissolved cadmium in Chollas Creek exceed neither acute nor chronic CTR water quality criteria. Consequently, the Regional Board has recommended Chollas Creek for delisting with respect to cadmium to the State Water Resources Control Board (SWRCB). The SWRCB is preparing the latest update of the List of Water Quality Limited Segments.

The purpose of this TMDL project is to attain WQOs for copper, lead and zinc, and restore and protect the beneficial uses of Chollas Creek. TMDLs represent a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. A TMDL is defined as the sum of the individual wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background [40 CFR section 130.2] such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded. In order to achieve the TMDLs, an Implementation Action Plan is also developed that describes the pollutant reduction actions that must be taken by various responsible persons to meet the wasteload and load allocations. The Implementation Action Plan includes a time schedule for meeting the required allocations and requirements for monitoring to assess the effectiveness of the load reduction activities in attaining water quality objectives and restoring beneficial uses.

Once established, the regulatory provisions of this TMDL project are incorporated into the Basin Plan. Additional requirements of the Basin Plan amendment process also

[1] The Chollas Creek Watershed comprises Hydrologic Unit number 908.22.

include an evaluation of economic and environmental considerations. As with any Basin Plan amendment involving surface waters, a TMDL project will not take effect until it has undergone subsequent agency approvals by the SWRCB, and the Office of Administrative Law (OAL). The TMDL is also submitted for approval to the U.S. Environmental Protection Agency (USEPA).

2. Numeric Targets

When calculating TMDLs, numeric targets are established to ensure that WQOs are met and beneficial uses are protected. The CTR is the basis of the numeric targets. Specifically, the numeric targets for the Chollas Creek TMDLs were set equal to the CTR's WQOs, which are comprised of hardness-based equations for dissolved copper, lead and zinc. Equations, rather than numbers comprise the WQOs because the toxicity of dissolved copper, lead, and zinc varies significantly depending on hardness. The CTR was chosen as the basis for these numeric targets because it has the most current, defendable WQOs for dissolved copper, lead and zinc concentrations in fresh water (USEPA, 2000a). Additionally, the CTR is legally applicable in inland surface waters (e.g., Chollas Creek), enclosed bays and estuaries of California for all purposes and programs under the CWA (USEPA, 2000a).

3. Source Analysis

For Chollas Creek, essentially all metals sources (point and nonpoint) are discharged through municipal separate storm sewer system (MS4) that is regulated under Order No. 2001-0001.[2] Metals sources are thus collectively considered point sources due to their release from channelized, discrete conveyance pipe systems and outfalls. Known point source discharges to the MS4s include stormwater discharges from industrial facilities, construction sites, underground utility vaults, and groundwater discharges from de-watering sites. These discharges are regulated under different statewide and Regional Board orders prescribing general WDRs. Because there are no other known point sources, urban runoff is considered the most significant source of metals to Chollas Creek.

Watershed models were developed by Tetra Tech, Inc. to estimate the magnitude and land use sources of existing annual metal loadings to the Chollas Creek Watershed during both wet and dry weather conditions of a typical year. Modeling results based on land use category parameters, hydrological characteristics and observed metal concentrations provided estimates of the magnitude of metal loadings. The top two land use categories in Chollas Creek, freeways and commercial/institutional, contribute over 75 percent of the total load for each metal. Significant sources of all three metals to urban runoff are thought to include automobile operation (especially brake pads and tires) and industries with practices that may expose metals to stormwater. Water supply infrastructure

[2] Order No. 2001-0001, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758 or subsequent superceding NPDES renewal Orders.

corrosion, pesticide application and atmospheric deposition are also among the identified potential sources. Additionally, another potential source of metals in urban runoff from activities outside and inside of the Chollas Creek Watershed boundaries is atmospheric deposition.

Nonpoint sources are conveyed to Chollas Creek through the MS4 system and thus, are accounted for in the point source MS4 discharges. Because of this, and the lack of data to prove otherwise, any nonpoint source that discharges directly into Chollas Creek is assumed to be comparatively insignificant.

4. Linkage Analysis

The TMDL technical report must estimate total assimilative capacity (loading capacity) of Chollas Creek for the metals and describe the relationship between Numeric Targets and identified metal sources. Collectively, these requirements are termed the linkage analysis and provide the necessary quantitative link between the TMDL and attainment of water quality standards.

The total assimilative capacity, or loading capacity, is the maximum amount of pollutant that a water body can assimilate while maintaining WQSs. The loading capacity is also a function of different hydrodynamic processes that affect the environmental fate and transport of dissolved metals as they move through the system. At Chollas Creek, the loading capacity for each metal is estimated to be equal to its respective Numeric Target. Because the Numeric Target are on CTR, these loading capacities will attain WQSs, because the Numeric Targets are at a minimum to be protective of aquatic life and are thus conservatively considered the total loading capacity for Chollas Creek. Table E.1 presents the loading capacities for metals copper, lead and zinc.

TABLE E.1 Dissolved metals loading capacities for acute and chronic conditions.

Metal	Loading Capacity for Acute Conditions – One-Hour Average	Loading Capacity for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as “ln” and “e”, respectively.

These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Regulated discharges from each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have dissolved metals concentrations that causes in-stream waters to exceed the loading capacities. Furthermore, all other sources of copper, lead and zinc to Chollas Creek will be expected to not cause the creek to exceed these loading capacities. Once these capacities are achieved, Chollas Creek copper, lead and zinc concentrations will be protective of the creek's beneficial uses.

A concentration-based approach was chosen to link the Numeric Targets with the largest identified metal source -- urban runoff. This approach is considered more appropriate than a mass-based approach, because not only does it take into account the dynamic nature of urban runoff, which is greatly affected by stormwater, but it also accommodates the dynamic nature of freshwater systems that have a myriad of flow and hardness conditions.

In addition, a mass-based approach would be more sensitive to concerns of accumulated bottom sediment in fresh water bodies and down stream sediment toxicity. However, sediment is not considered a source of metals due to the nature of Chollas Creek and due to low sediment toxicity results. In addition, downstream sediment toxicity is to be addressed in a separate TMDL for San Diego Bay at the mouth of Chollas Creek once adequate data are collected and applicable models are developed for the Chollas Creek Watershed.

5. Margin of Safety

The TMDL must contain a margin of safety (MOS) to account for uncertainty in the analysis. The MOS for Chollas Creek is explicit as well as implicit. The explicit MOS was incorporated by setting the wasteload allocations equal to 90 percent of the total loading capacity as generated from the CTR equations, using the sampled hardness concentrations. The decision to use actual hardness values in the CTR equation in order to calculate TMDLs established an implicit MOS.

6. TMDLs and Allocations

The TMDL must be less than or equal to the loading capacity after taking into account allocations to all sources. The TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a MOS that may either explicitly reserve an allocation for or implicitly account for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. In this TMDL, 10 percent of the load is reserved for an MOS, or not allocated to sources, in order to account for identified uncertainties in the TMDL in addition to conservative assumptions made in the TMDL analysis (Margin of Safety Section).

In TMDL development, allowable WLA and LA from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. For Chollas Creek, the WLAs and LAs and consequently the TMDL, are expressed as concentrations derived from the CTR acute and chronic WQO equations for dissolved copper, lead, and zinc. In addition, the concentration-based TMDL will account for any future point or nonpoint sources, because any future sources will also be required to be below the same concentration.

Concentration-based allocations are not additive; therefore, the allocations for point, nonpoint and background sources (WLAs and LAs) will all be the same concentration for each metal. Further, the LAs and WLAs for Chollas Creek are set equal to the loading capacities for both acute and chronic conditions. In addition, an explicit MOS reserves 10 percent of the total allocation ($\sum$ WLAs + $\sum$ LAs) and subsequently reduces the TMDL (and therefore the WLA and LA) concentration by the same amount. If all copper, lead and zinc contributing sources to Chollas Creek meet their respective TMDL concentration, the loading capacity in the creek should not be exceeded.

TABLE E.2 Dissolved metals loading capacities for acute and chronic conditions, as determined by sampling requirements in TABLE 4.2.

Metal	Loading Capacity for Acute Conditions – One-Hour Average	Loading Capacity for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as “ln” and “e”, respectively.

TABLE E.3 Total Maximum Daily Loads for dissolved copper, lead and zinc for acute and chronic conditions

Metal	TMDL for Acute Conditions – One-Hour Average	TMDL for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

The natural log and exponential functions are represented as “ln” and “e”, respectively.

7. Wasteload Allocations

The Chollas Creek metals WLAs are expressed as concentrations equal to 90 percent of the loading capacities for the three metals. Federal regulations require TMDLs to include individual WLAs for each point source discharge. The point source discharges that could affect Chollas Creek are the MS4 discharges, stormwater discharges from industrial sites, and discharges of extracted groundwater. All point source discharges to Chollas Creek will be required to achieve this WLA.

Modeling results demonstrate the possible land use specific and sub-watershed specific contributions of copper, lead and zinc. However because this WLA is concentration-based it will apply to each land use and each sub-watershed at all times and will not be specific to any land use or sub-watershed. Therefore, the model predictions of the relative metal contribution from each category will be useful in targeting problem areas during implementation.

8. Load Allocations

The LAs are assigned to nonpoint sources and natural background sources in the watershed. Background sources can include air deposition of metals in the watershed and any groundwater contributions. Because of the regulatory definition of the MS4 system, all source (point and nonpoint sources) contributions of metals to Chollas Creek come via the MS4s and are therefore accounted for when an allocation is made for the MS4. The only other possible sources that may end up directly in Chollas Creek would be direct air deposition and groundwater, which may or may not include anthropogenic sources. These two sources are not considered significant at this time. These sources may be re-evaluated at a future date if any additional data become available. Currently, the point sources not already accounted for in the WLAs to the MS4s are considered to be relatively insignificant. Thus, the LAs are equal to zero in these TMDLs, and the TMDL calculations are equal to the WLAs.

9. Seasonal Variations and Critical Conditions

In accordance with federal regulations, a TMDL must consider seasonal variations and critical conditions (e.g. stream flows, pollutant loadings and other water quality parameters). A flow-based approach was used for the Chollas Creek Metals TMDL, and defines critical conditions solely based on freshwater flow rates regardless of season. No matter the time of year or situation, toxicity allocations that are based on the CTR equations will be required throughout all segments of Chollas Creek and therefore, by definition, will always be protective of aquatic life.

Furthermore, the flow-based approach is appropriate because the main sources of metal accumulation in the Chollas Creek Watershed are non-seasonal (e.g. automobile wear, exhaust emissions, industry contributions). Urban runoff, which is the main mechanism by which these accumulated metals reach Chollas Creek, can occur in both dry and wet weather.

The allowable concentrations will be determined with hardness values measured at the time of compliance. These data will provide a direct measure of any seasonal variations and/or critical conditions effects on hardness. Since hardness is an essential component of the WLAs, seasonal variations and/or critical conditions will be covered by this

TMDL. This method of using sampled hardness as the variable instead of an estimated hardness, will account for these effects because it is an absolute representation of current conditions and thus will account for any effects that may be caused by seasonal variations or extreme conditions. Other stream chemistry, which may or may not be a function of seasonal variations and critical conditions, were not taken into consideration as an implicit MOS and will therefore not have a bearing, with respect to seasonal variations and critical conditions, on the TMDL.

10. Implementation Action Plan

Following TMDL project approvals by the OAL, the Regional Board is required to incorporate the regulatory provisions of the TMDL into all applicable orders prescribing WDRs, or other regulatory mechanisms. Numeric limits for the impairing pollutant in the subject watershed may be added to the appropriate WDRs to implement and make the TMDL enforceable. The CWA requires that WDRs that implement federal NPDES regulations be consistent with all applicable TMDLs.

The purpose of these TMDLs is to attain and maintain the applicable WQOs in Chollas Creek through incremental mandated wasteload reductions of pollutants in point sources discharging to the creek. The TMDL requires dischargers to improve water quality conditions in the Chollas Creek receiving water by achieving wasteload reductions in their discharges. The copper, lead and zinc TMDLs shall be implemented in an incremental approach with a monitoring component to determine the effectiveness of each phase and guide the selection of BMPs.

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first five years after adoption of this TMDL. Allowable concentrations shall decrease by 20 percent each year during this time (Table E.4). For example, if the measured hardness four years after OAL approval of this TMDL project dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 14 µg/L. The phases require loading reductions in incremental steps through the use of expanded or better tailored BMPs to achieve the ultimate goal of attaining and maintaining compliance with copper, lead, and zinc water quality objectives. By the end of the seventh year after OAL approval of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead and zinc water quality objectives are being met at all locations in the creek during all times of the year.

Table E.4 Compliance Schedule and Interim Goals for Achieving Wasteload Allocations

	Allowable Exceedance of the WLAs (allowable percentage above)		
Compliance Year (year after OAL approval)	**Copper**	**Lead**	**Zinc**
1	100%	100%	100%
2	100%	100%	100%
3	100%	100%	100%
4	50%	50%	50%
5	25%	25%	25%
6	10%	10%	10%
7	0%	0%	0%

Compliance with the interim goals in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQOs for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in Table E.4.

The cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego and the San Diego Unified Port District (Municipal Dischargers) are all in the Chollas Creek Watershed and should be involved in addressing water quality concerns for the MS4 in the Chollas Creek Watershed. Specifically, the Regional Board shall amend Order No. 2001-0001 to require that MS4 discharges to Chollas Creek not exceed the WLAs for copper, lead and zinc as established in this TMDL in accordance with a seven year time schedule to reduce metal concentrations in urban runoff to achieve the WLAs. The Regional Board shall also amend Order No. R9-2004-0277, pursuant to CWC section 13383, requiring the Municipal Dischargers and the California Department of Transportation (CalTrans) to investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek. Annual reporting on the progress and efficacy of implementation elements will be required.

CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, including the portion of the Interstate Highway System within the State's boundaries. The roads and highways operated by CalTrans are legally defined as MS4s and discharges of pollutants from CalTrans MS4s to waters of the United States, such as Chollas Creek, constitute a point source discharge that is subject to regulation under WDRs implementing federal NPDES regulations. Discharges of storm water from the CalTrans owned right-of-ways, properties, facilities, and activities, including stormwater management activities in construction, maintenance, and operation of State-owned highways are regulated under Order No. 99-06-DWQ.[3] CalTrans is responsible, under the terms and conditions of these WDRs, for ensuring that their operations do not contribute to violations of water quality objectives in Chollas Creek. The Regional Board shall request that the SWRCB amend Order No. 99-06-DWQ to include the WLA and other requirements established in this TMDL project, including the

[3] Order No. 99-06-DWQ *National Pollutant Discharge Elimination System Permit, Statewide Storm Water Permit, and Waste Discharge Requirements for the State of California, Department of Transportation (CalTrans).*

requirement to submit annual reports on CalTrans' progress in achieving the WLAs in discharges from its MS4s.

Finally, the U.S. Navy (Navy) generates urban runoff at Naval Station San Diego near the mouth of Chollas Creek Watershed. Upon submittal of a complete Report of Waste Discharge (ROWD), these MS4 discharges can be regulated by the SWRCB via their general order prescribing WDRs for small MS4s.[4] These WDRs regulate MS4 discharges not covered by the Regional Board's Order No. 2001-0001, including those from MS4s on military bases. The Regional Board will require the Navy to submit a ROWD.

At a minimum, this is likely to include amending Order No. R9-2000-90,[5] which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries and the general statewide WDR that regulate stormwater discharges from industrial sites[6]. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges.

The first three years after OAL approval of this TMDL project are not likely to require a reduction from current concentrations of all three metals. These years will provide the dischargers time to develop plans, and implement enhanced and expanded Best Management Practices (BMPs) that should result in immediate decreases of metal concentrations in the Chollas Creek water column. Subsequent years will see an incremental decrease in the allowable percentage exceedance of the water quality objectives for copper, lead and zinc. Finally, at year seven, dischargers will be expected to meets the WLA in their effluent discharges, and WQOs for metals in Chollas Creek.

11. Implementation Monitoring Plan

Compliance monitoring will be required in the creek itself to measure the progress of BMP implementation effectiveness and finally to ensure that the water quality objectives for copper, lead and zinc are being achieved. Order No. R9-2004-0277 (the Chollas Creek Investigation Order for Diazinon and Metals) will be reviewed by the Regional Board, and if needed, amended to require the dischargers to collect the data necessary to refine the watershed model so that mass loads of copper, lead and zinc leaving the

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[4] State Water Resources Control Board Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems* or subsequent superceding NPDES renewal Orders.

[5] Order No. R9-2000-90, NPDES Permit No. CAG919001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or Other Conveyance Systems Tributary Thereto* or subsequent superceding NPDES renewal Orders.

[6] Order No. 97-03-DWQ, NPDES Permit No. CAS000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities* or subsequent superceding NPDES renewal Orders.

Chollas Creek watershed can be more accurately estimated. This information will be used to refine the TMDLs and in the development of the TMDL for Metals in San Diego Bay at the mouth of Chollas Creek. The Regional Board has considered the costs of the reasonably foreseeable methods of compliance with the load and wasteload reductions specified in this TMDL.

12. Environmental Review

The basin planning process is a certified regulatory program that is certified as functionally equivalent to the California Environmental Quality Act (CEQA) process and exempt from the requirements to prepare an initial study, negative declaration and environmental impact report. The staff report for this TMDL fulfills the Regional Board's requirement for the preparation of environmental documents (Public Resources Code section 21081.5). The required environmental documentation (Basin Plan amendment, technical report, and environmental checklist) has been prepared. A public CEQA scooping meeting was held in March 2003. Consultation with responsible parties and persons with expertise has occurred. Written responses to comments were provided 15 days before the board meeting and a notice of filing and certification of fee exemption has been submitted to the appropriate agencies. This Basin Plan amendment will result in no potential for adverse effect, either individually or cumulatively, on wildlife.

The environmental review examined the potential adverse environmental impacts caused by the most reasonably foreseeable method of compliance with the TMDL. Attainment of the WLAs will be achieved through discharger implementation of structural and nonstructural BMPs control strategies designed to reduce metals concentrations in urban runoff and stormwater. Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event.

The environmental checklist, found in Appendix I, describes the potential for environmental impacts associated with the reasonably foreseeable compliance method. The environmental checklist indicates that the TMDL Basin Plan amendment will not have any direct adverse environmental impacts. The implementation of this TMDL project will in effect lead to an overall improvement in the quality of water and therefore the quality of the environment.

The environmental checklist indicated potential, or indirect, environmental impacts could arise from treatment control BMP projects that could be implemented to comply with the Chollas Creek TMDL project. However, identifying the specific projects that the dischargers might implement is overly speculative at this time. The precise nature, location, and significance of the environmental impacts of possible projects cannot be determined at this time, since the TMDL implementation action plan establishes a process for identifying subsequent BMP projects rather than specifying particular projects at specific locations. Future CEQA documents prepared for specific BMP implementation projects will identify site-specific environmental impacts and the need for feasible mitigation measures. This CEQA Checklist (Appendix I) identifies the environmental impacts associated with treatment control BMPs in general and proposed appropriate mitigation measures are discussed below.

BMPs implemented by the dischargers could have a potentially significant impact on the environment unless mitigation is incorporated into the BMP with respect to riparian habitat or other sensitive natural communities. Adverse environmental impacts are more often associated with treatment control BMPs rather than source control BMPs. Examples of potential impacts and mitigation associated with treatment control BMPs that might be implemented are discussed below.

In order to remove metals during dry weather, diversion systems may be put into place in Chollas Creek. While the use of diversion systems during dry weather may result in decreased metal concentrations in the creek, the removal of water from the creek could alter the hydrology of the stream and result in adverse impacts to aquatic life dependent on the stream. Mitigation to lessen any such impacts may involve diverting only a portion of the water from the creek sufficient to remove metals but not to significantly alter the creek's hydrology. An additional mitigation measure could involve returning treated water to the stream.

Another potential adverse impact resulting from the use of diversion systems involves the potential for entrainment of fauna and flora from the creek. As a mitigation measure to avoid entraining flora and fauna, diversion systems may be set up that divert flow "in-pipe," (i.e. in the storm drain), rather than in the creek. Furthermore, screens may be put into place to help prevent the uptake of aquatic organisms. Diversion systems should be properly maintained to ensure that they function appropriately and do not result in adverse environmental impacts.

Potential adverse impacts may also result from the use of treatment control BMPs that increase the likelihood of vectors and pests. For example, constructed basins and vegetated swales may develop locations of pooled standing water that would increase the likelihood of mosquito breeding. Mitigation may involve the prevention of standing water through the construction and maintenance of appropriate drainage slopes and through the use of aeration pumps.[7] Mitigation for vectors and pests should involve the use of appropriate vector and pest control strategies and maintenance such as frequent inspections to prevent adverse environmental impacts.

Certain types of treatment control BMPs such as infiltration trenches and infiltration basins may result in the accumulation of metals to potentially hazardous levels. The accumulation of metals in turn could lead to contamination of groundwater. Mitigation may involve regular inspections, monitoring, and maintenance including disposal of waste at appropriate landfills when necessary.

Another potential adverse environmental impact could result from the introduction and/or establishment of invasive species in wet ponds and bioretention BMPs. Vegetation should be chosen to help reduce or eliminate this possibility, and the BMPs should be

[7] *http://www.cabmphandbooks.com/Municipal.asp*

maintained and inspected routinely to identify the establishment of any potentially invasive species.

In conclusion, implementation measures should be chosen to reduce metals loading to Chollas Creek. Efforts should first be aimed at source control and then at treatment control since treatment control BMPs have greater potential for adverse environmental impacts. Appropriate mitigation including frequent inspections and maintenance should be incorporated to reduce or eliminate any adverse environmental impacts.

13. Peer Review

The scientific basis of this TMDL has undergone external peer review pursuant to Health and Safety Code section 57-004. The Regional Board has considered and responded to all comments submitted by the peer review panel. Interested persons and the public have had reasonable opportunity to participate in review of the amendment to the Basin Plan. Efforts to solicit public review and comment include five public workshops held between April 1999 and April 2005; a public review and comment period of 45 days preceding the Regional Board public hearing; and written responses from the Regional Board to oral and written comments received from the public. The Regional Board has notified all known interested parties and the public of its intent to consider adoption of this Basin Plan amendment in accordance with CWC section 13244

TECHNICAL ANALYSIS

1. BACKGROUND

Chollas Creek[8] is an urban coastal stream in southern San Diego County, and a tributary to San Diego Bay. Portions of the cities of San Diego, Lemon Grove, and La Mesa are located within the Chollas Creek Watershed. Chollas Creek was placed on the Clean Water Act (CWA) section 303(d) List of Water Quality Limited Segments (List of Water Quality Limited Segments) in 1996 for the metals cadmium,[9] copper, lead and zinc. The California Regional Water Quality Control Board, San Diego Region (Regional Board) has established Total Maximum Daily Loads (TMDLs) for copper, lead and zinc as required by the CWA for water quality limited segments. The Introduction section of this report describes the TMDL process in general. The sections 3 through 9 comprise the seven required components of a TMDL technical report.

2. INTRODUCTION

Section 303(d)(1)(A) of the CWA requires that "Each state shall identify those waters within its boundaries for which the effluent limitations…are not stringent enough to implement any water quality standard (WQS) applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the List of Water Quality Limited Segments and to establish TMDLs for such waters.

The purpose of a TMDL is to attain water quality objectives (WQOs) and restore and protect the beneficial uses of an impaired waterbody. TMDLs represent a strategy for meeting WQOs by allocating quantitative limits for point and nonpoint pollution sources. A TMDL is defined as the sum of the individual waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources and natural background [40 CFR 130.2] such that the capacity of the waterbody to assimilate pollutant loading (i.e., the loading capacity) is not exceeded.

The TMDL process begins with the development of a technical report which includes the following 7 components: (1) a **Problem Statement** describing which WQOs are not being attained and which beneficial uses are impaired; (2) identification of **Numeric Targets** which will result in attainment of the WQOs and protection of beneficial uses; (3) a **Source Analysis** to identify all of the point and nonpoint sources of the impairing pollutant in the watershed and to estimate the current pollutant loading for each source; (4) a **Linkage Analysis** to calculate the **Loading Capacity** of the waterbody for the pollutant; which is the maximum amount of the pollutant that may be discharged to the waterbody without causing exceedances of WQOs and impairment of beneficial uses; (5) a **Margin of Safety** (MOS) to account for uncertainties in the analysis; (6) the division and **Allocation** of the TMDL among each of the contributing sources in the watershed, WLAs for point sources and LAs for nonpoint and background sources; and (7) a description of how **Seasonal Variation and Critical Conditions** are accounted for in the

[8] The Chollas Creek Watershed comprises Hydrologic Unit number 908.22.
[9] Cadmium is recommended for de-listing. See Appendix B.

TMDL determination. A document, like this report, containing the above components is generally referred to as the technical report.

The report also includes an **Implementation Action Plan** that describes the pollutant reduction actions that must be taken by various persons accountable for taking actions to meet the allocations specified in the technical report. A time schedule for meeting the required pollutant allocations is included in the Implementation Plan. In addition, the Implementation Action Plan also includes requirements for an Implementation Monitoring Plan that must be implemented to assess the effectiveness of the load reduction activities in attaining allocations and WQOs in Chollas Creek and restoring beneficial uses. Public participation is a key element of the TMDL process and stakeholder involvement is encouraged and required.

Once established, the regulatory provisions of the TMDL, Implementation Action Plan and Implementation Monitoring Plan are incorporated into the Water Quality Control Plan for the San Diego Basin (9) (Basin Plan; Regional Board, 1994). The Regional Board, following a public comment period and hearing process, has adopted a resolution that amends the Basin Plan to incorporate the TMDL. Additional requirements of the Basin Plan amendment process also include an evaluation of economic and environmental considerations. As with any Basin Plan amendment involving surface waters, a TMDL amendment will not take effect until it has undergone subsequent agency approvals by the State Water Resources Control Board (SWRCB), the Office of Administrative Law (OAL) and the United States Environmental Protection Agency (USEPA).

Following these approvals, the Regional Board is required to incorporate the regulatory provisions of the TMDL into all applicable orders prescribing waste discharge requirements (WDRs), or other regulatory mechanisms. Numeric limits for the impairing pollutant in the subject watershed are incorporated in the appropriate WDRs to implement and make the TMDL enforceable. The CWA requires that WDRs issued pursuant to the National Pollutant Discharge Elimination System (NPDES) provisions of the CWA be consistent with all applicable TMDLs.

The final and most important step in the process is the implementation of the TMDL by dischargers. Per the governing WDR order (or other regulatory mechanism), each discharger must reduce its current loading of the pollutant to its assigned allocation of the pollutant in accordance with the time schedule specified in the technical report (and implementing WDR order). When each responsible party has achieved its required load reduction, water quality standards for the impairing pollutants are expected to be restored in the receiving water.

3. PROBLEM STATEMENT

The lowest 1.2 miles of Chollas Creek were placed on the List of Water Quality Limited Segments in 1996 for stormwater toxicity, coliform[10] and the metals cadmium,[11] copper, lead and zinc. While only the lowest 1.2 miles of Chollas Creek comprise the actual impaired and listed segment of the water body, all upstream tributaries to this section are considered in this TMDL because they deliver metals loads to the lower segments. Samples collected at station SD8(1) (Figure 3.1) under Order No. 2001-01,[12] repeatedly showed toxicity to the water flea, *Ceriodaphnia dubia*. A subsequent Toxicity Identification Evaluation (SCCWRP, 1999) for three storm events identified zinc, copper and the pesticide diazinon[13] as the principal causes of toxicity.

Since 1994, stormwater samples from Chollas Creek have frequently exceeded both chronic and acute water quality criteria established in the National Toxics Rule (NTR) in federal regulations [40 CFR 131.36 (d)(10)(ii)] for copper, lead, zinc and cadmium. In the NTR, both 1-hour acute and 4-day chronic water quality criteria are calculated as a function of hardness and the criteria are then compared against measured event mean concentrations (EMC). The EMC is defined as the total pollutant load divided by the total runoff volume. If the measured EMC was equal to or greater than acute or chronic criteria, the result was considered to exceed water quality criteria. Comparisons against NTR criteria were partially responsible for the original listing of Chollas Creek in 1996 for cadmium, copper, lead and zinc.

In April 2000, the USEPA promulgated the California Toxics Rule (CTR) [40 CFR 131.38] that established new water quality criteria for waters in California, including water quality criteria for copper, lead, zinc and cadmium. As in the NTR, both 1-hour acute and 4-day chronic water quality criteria are calculated as a function of hardness.

The criteria are compared against measured concentrations of the dissolved metal (NTR assessed total metal concentration). Storm water samples from Chollas Creek collected between 1994 and 2003 periodically exceeded CTR water quality criteria for only copper, lead and zinc (Table 3.1 and Appendix A). For each concentration that exceeded criteria, an exceedance factor was calculated. For example, if a concentration was two times greater than criteria, the exceedance factor was 2.0. California must comply with the more stringent criteria of CTR rather than NTR.

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[10] This section 303(d) listing for coliform has since been changed to “Bacterial Indicators.” A separate TMDL is currently under development that addresses several Bacterial Indicator listings throughout the region.
[11] Cadmium is recommended for de-listing. See Appendix B.
[12] Order No. 2001-01, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758.
[13] A separate TMDL for diazinon was developed by the Regional Board and adopted by the USEPA in November 2003.

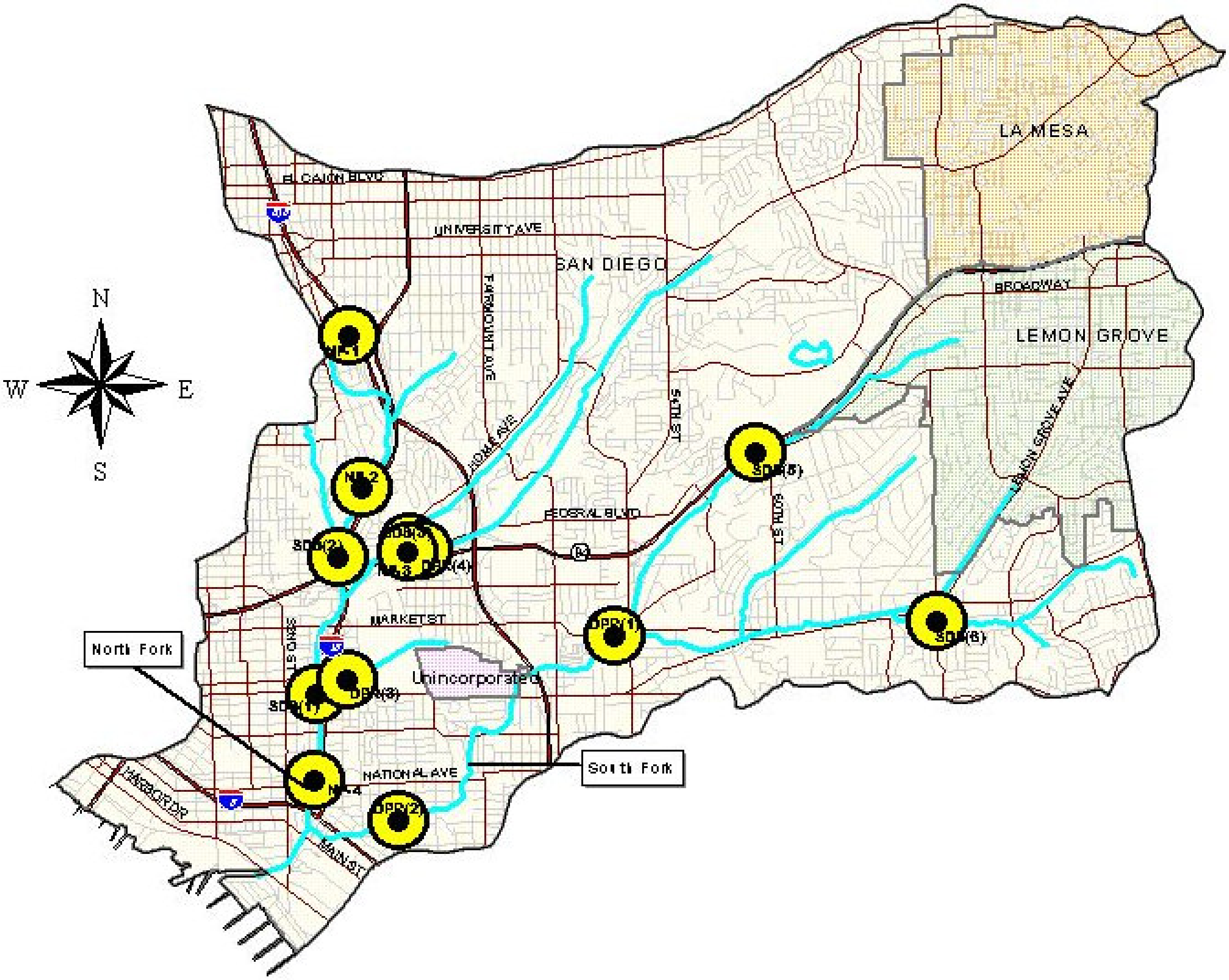

FIGURE 3.1. Chollas Creek Watershed.

3.1. De-listing of Cadmium

The available data suggest that concentrations of dissolved cadmium in Chollas Creek exceed neither acute nor chronic CTR water quality criteria. Most samples were below DLs, though some of the DL concentrations exceed CTR acute and chronic criteria. Since cadmium did not appear to exceed dissolved CTR criteria and was not found to cause toxicity in test organisms, a TMDL for cadmium was not established in this project. Based on this evidence, the Regional Board recommended that cadmium be removed from the List of Water Quality Limited Segments in the 2004 listing update undertaken by the SWRCB. The USEPA has recommended (USEPA, 2001) a more stringent dissolved cadmium criteria that it hopes California will incorporate in to the CTR by 2008. These criteria are approximately ten-fold more stringent than current CTR criteria; and would warrant listing for exceedances of the chronic criteria (see Table 3.1 below). However, these criteria are only proposed and have not been promulgated by the USEPA.

TABLE 3.1. Metal data summaries.

CADMIUM			**Concentrations reported in ug / L**				**# of exceedances (CTR) [D]**		**# of exceedances (USEPA, 2001) [D]**	
Collection Dates	**Organization**	**n**	**min**	**max**	**mean**	**median**	**CMC**	**CCC**	**CMC**	**CCC**
Feb 94 - Feb 03	MS4 Copermittees	42	0.2 [A]	3.93 [B]	0.8 [C]	0.5 [C]	0 of 4	0 of 4	0 of 4	3 of 4
Feb 00 - Apr 00	CalTrans	4	0.2 [A]	0.3	0.2 [C]	0.2 [C]	NA [E]	NA [E]	NA [E]	NA [E]
Mar 99 - Apr 99	SCCWRP	3	< 0.3	< 2.0	< 2.0	< 2.0	NA [F]	NA [F]	NA [F]	NA [F]
Jun 91 & Mar 92	Regional Board	5	1.0 [A]	< 1.0	0.5 [C]	0.5 [C]	NA [F]	NA [F]	NA [F]	NA [F]

COPPER			**Concentrations reported in ug / L**				**# of exceedances (CTR) [D]**	
Collection Dates	**Organization**	**n**	**min**	**max**	**mean**	**median**	**CMC**	**CCC**
Feb 94 - Feb 03	MS4 Copermittees	58	2.5 [A]	81.6 [B]	16.4 [C]	11.0 [C]	16 of 32	20 of 32
Feb - Apr, 00	CalTrans	4	5.1	11	7.8	7.5	NA [E]	NA [E]
Feb - Mar, 00	SCCWRP	2	51.2	63	57.1	57.1	NA [E]	NA [E]
Jan , Feb & Nov, 01	DPR	14	5	34	11.7	9.8	5 of 12	7 of 12
Sep-00	ES Babcock	4	1.92	28.8	9.8	4.3	NA [G]	NA [G]
Mar - Apr 99	SCCWRP (TIE)	3	10	30	18.3	15	2 of 3	3 of 3
Jun 91 & Mar 92	Regional Board	5	3	8	6.4	7	0 of 5	0 of 5

LEAD			**Concentrations reported in ug / L**				**# of exceedances (CTR) [D]**	
Collection Dates	**Organization**	**n**	**min**	**max**	**mean**	**median**	**CMC**	**CCC**
Feb 94 - Feb 03	MS4 Copermittees	57	1.0 [A]	118 [B]	16.4 [C]	3.0 [C]	0 of 19	10 of 19
Feb - Apr, 00	CalTrans	4	2.9	11	5.5	4	NA [E]	NA [E]
Jan , Feb & Nov, 01	DPR	14	1..0 [A]	46	7.3	2	1 of 12	6 of 12
Sep-00	ES Babcock	4	2.0 [A]	4.1	1.9	1.2	NA [G]	NA [G]
Mar - Apr 99	SCCWRP (TIE)	3	10.0 [A]	82	39	30	1 of 2	2 of 2
Jun 91 & Mar 92	Regional Board	5	5.0 [A]	29	12.2	11	0 of 3	1 of 3

ZINC			**Concentrations reported in ug / L**				**# of exceedances (CTR) [D]**	
Collection Dates	**Organization**	**n**	**min**	**max**	**mean**	**median**	**CMC**	**CCC**
Feb 94 - Feb 03	MS4 Copermittees	57	8	548 [B]	105.6 [C]	73 [C]	12 of 42	12 of 42
Feb - Apr, 00	CalTrans	4	17	42	28.8	28	NA [E]	NA [E]
Feb - Mar, 00	SCCWRP	2	146	150.8	148.4	148.4	NA [E]	NA [E]
Jan , Feb & Nov, 01	DPR	14	16.8	370	137.6	105	7 of 12	7 of 12
Sep-00	ES Babcock/RB	4	10.0 [A]	45	21.3	17.5	NA [G]	NA [G]
Mar - Apr 99	SCCWRP (TIE)	3	90	220	173.3	210	2 of 3	2 of 3
Jun 91 & Mar 92	Regional Board	5	3	188	45	11	0 of 5	1 of 5

[A] sample below Reporting Limit
[B] calculated from total concentration
[C] using all samples (measured dissolved and calculated from total). Samples below detection limit entered as 1/2 detection limit for calculations
[D] considering only measured dissolved concentrations and samples not below DL or RL. (number in parenthesis represents available sample pool under these criteria)
[E] no associated hardness values available
[F] all samples reported as "less than"
[G] all dissolved samples calculated from total [ ]

When and if the CTR is updated to incorporate these criteria, the Regional Board will re-evaluate the potential listing of cadmium for Chollas Creek. Appendix B contains the details supporting the cadmium delisting recommendation.

3.2. Watershed Characteristics

Chollas Creek is an urban creek with highly variable flows. The highest flow rates are associated with storm events. Extended periods with no surface flows occur during dry weather, although pools of standing water may be present. The annual average rainfall in the Chollas Creek Watershed is approximately 9 inches (URS Greiner Woodward Clyde 1999). The average annual rainfall in the watershed (from October 1948 through February 2002) measured at La Mesa, CA is approximately 12.6 inches (Western Regional Climate Center, 2003). Rainfall statistics for the San Diego International Airport (Lindbergh Field, located approximately 4 miles northwest of Chollas Creek, near San Diego Bay) indicate that an average of 18 storms occur each year (URS Greiner Woodward Clyde 1999).

Much of the creek has been channelized and concrete lined, but some sections of earthen creek bed remain. The mouth of the creek is located on the eastern shoreline of the central portion of San Diego Bay. San Diego Bay at the mouth of Chollas Creek is also on the List of Water Quality Limited Segments; being impaired for sediment toxicity and degraded benthic community.

The watershed of Chollas Creek encompasses 16,273 acres. The area of the north fork of the watershed (9,276 acres) is larger than that of the south fork (6,997 acres) (URS Greiner Woodward Clyde 1999). As Table 3.2 indicates, the watershed is highly urbanized. Land use is predominantly residential, with some commercial and industrial use. A significant portion of the remainder of the watershed consists of roadways, while the rest is open space. Portions of the cities of San Diego, Lemon Grove, and La Mesa are located within the watershed. A small portion of the watershed consists of “tidelands” immediately adjacent to San Diego Bay. Some of this tideland area is under the jurisdiction of the San Diego Unified Port District (Port); the remainder is under the jurisdiction of the U.S. Navy (Navy). San Diego County also holds jurisdiction over a small portion of the watershed (<1.0 percent) as shown in Figure 3.1.

TABLE 3.2. Land use in the Chollas Creek Watershed.
(URS Greiner Woodward Clyde 1999)

Land Use	Percent of Total Area (Entire Watershed)
Residential	67%
Commercial	5%
Industrial	7%
Roadways	4%
Open Space	16%

3.3. Applicable Water Quality Standards

WQSs consist of beneficial uses and WQOs. The Basin Plan (Regional Board, 1994) specifies WQSs for all waters in the San Diego region, including Chollas Creek and San Diego Bay. The WQSs that apply to this TMDL are the existing and potential beneficial uses in Chollas Creek that could be adversely affected by toxicity, combined with the Basin Plan narrative WQOs for toxicity, and the numeric criteria for toxic pollutants found in the federal California Toxics Rule. The beneficial uses for Chollas Creek and San Diego Bay are listed in Table 3.3. Chollas Creek is also subject to SWRCB Resolution No. 68-16, *Statement of Policy with Respect to Maintaining High Quality of Waters in California*, which establishes a general principle of non-degradation.

TABLE 3.3. Beneficial uses in the Chollas Creek Watershed and San Diego Bay.

Beneficial Use	Chollas Creek	San Diego Bay
Industrial service supply		•
Navigation		•
Contact water recreation	o	•
Non-contact water recreation	•	•
Commercial and sport fishing		•
Preservation of biological habitats of special significance		•
Estuarine habitat		•
Warm freshwater habitat	•	
Wildlife habitat	•	•
Rare, threatened, or endangered species		•
Marine habitat		•
Migration of aquatic organisms		•
Shellfish harvesting		•

• Existing Beneficial Use
o Potential Beneficial Use

There are no numerical WQOs in the Basin Plan for metals in Chollas Creek; however, the following Basin Plan narrative WQO (Basin Plan p. 3.15) for toxicity is applicable to all inland surface waters (including Chollas Creek), enclosed bays (including San Diego Bay) and estuaries, coastal lagoons and ground waters of the San Diego region.

> ***Water Quality Objective for Toxicity***
> *All waters shall be maintained free of toxic substances in concentrations that are toxic to, or that produce detrimental physiological responses in human, plant, animal, or aquatic life. Testing of indicator organisms, analyses of species diversity, population density, growth anomalies, bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board will be used to determine compliance with this objective.*
>
> *The survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality factors, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when*

necessary, for other control water that is consistent with requirements specified in USEPA, State Water Resources Control Board or other protocol authorized by the Regional Board. As a minimum, compliance with this objective as stated in the previous sentence shall be evaluated with a 96-hour acute bioassay.

In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available and source control of toxic substances will be encouraged.

In addition to Basin Plan objectives, the CTR also establishes applicable numeric water quality criteria legally applicable in the State of California as WQOs for inland surface waters and enclosed bays and estuaries. These criteria are discussed in full in the Numeric Targets section of the TMDL.

3.4. Metals Chemistry

Copper and zinc are essential elements for all living organisms, but elevated levels may cause adverse effects in all biological species. Lead is presumed to be a non-essential element for life; more importantly, even at extremely low environmental concentrations this element may create adverse impacts on biota. Dissolved forms of these metals are directly taken up by bacteria, algae, plants and planktonic and benthic organisms. Dissolved metals can also adsorb to particulate matter in the water column and enter aquatic organisms through various routes. Copper, lead and zinc may bioaccumulate within lower organisms, yet they are not expected to biomagnify up the food chain as do mercury and selenium (Moore and Ramamoorthy, 1984). The issue of biomagnification is still being debated among the scientific community (Besser, et al, 200) and cannot be assessed in Chollas Creek with the available information. Of all of these metals, copper is considered the most potent toxicant at environmentally relevant aqueous concentrations. Copper is more commonly found at higher concentrations in herbivorous fish than carnivorous fish from the same location (USF&W, 1998). Copper is used as an aquatic herbicide to reduce algae growth in reservoirs and is applied (via antifouling paints) to boat hulls in marinas.

The fate and transport of metals in natural waters is influenced by the physical state and chemical complexation of each element. Physical separation methods (i.e., filters) define metals associated with the particulate, colloidal, or dissolved phases. Unfiltered or "total" metal samples represent the sum of all size fractions; whereas filtered or "dissolved" samples yield metals in solution. As a general rule, particulate metal concentrations are higher than those in dissolved phase for all metals in this TMDL. This is based in part on the inherent reactivity of negatively charged particulate matter and positively charged metal ions (Buffle, 1989). As outlined in the CTR, the USEPA has defined aquatic life water quality criteria for these metals based on the dissolved fraction of aqueous samples (USEPA 2000a). These water quality criteria serve as numeric targets for the copper, lead and zinc TMDLs.

Exposure to two or more chemicals may result in toxicity that is additive or a simple summation of the toxicity of the individual chemicals. Likewise, the presence of two or more chemicals may result in a synergistic effect, or toxicity that is greater than would be expected based on a simple summation of the individual toxicities of the chemicals. Copper and zinc have been shown to have an additive toxic effect on aquatic life (Taylor and Francis, 1995). However, there is insufficient data to determine if these effects are found in Chollas Creek. This will be addressed as part of the monitoring required in the implementation (sections 11 and 12) phase of the TMDL.

3.5. Sediment Metals

Sediment samples have been collected for chemical analysis in Chollas Creek since 1994 (Appendix C), generally as a single sampling event every late spring and early fall. Extensive sampling occurred during June 1998 at several stations within the creek. All samples were analyzed for total cadmium, copper, lead and zinc (Table 3.4). With few exceptions, all four metals were below their applicable Probable Effects Level (PEL) (MacDonald et al., 1996). The PEL or Probable Effects Concentration (PEC) (MacDonald et al., 2000) is an empirical approach to determine what concentration of a chemical is likely to have an environmental impact. In the PEL approach, the chemical concentrations of the samples are ranked from high to low toxicity. The PEL is the geometric mean of the 50th percentile of the effects data and the 85th percentile of the no effects data. The PEL represents the concentration above which adverse effects are expected to occur frequently (Smith et al., 1996). Freshwater sediment chemistry regulations to protect aquatic life in California have not been promulgated. However, PELs were used to screen sediment chemistry data from San Diego Creek in a TMDL written by USEPA (2002) and are therefore appropriate to use as screening values in this TMDL.

TABLE 3.4. Summary of total metal concentrations in Chollas Creek sediments.

Metal	no. of detections / no. of samples analyzed	Average[1] (mg/kg, dry wt.)	Median[1] (mg/kg, dry wt.)	Std Dev[1] (mg/kg, dry wt.)	PEL[2] (mg/kg, dry wt.)	no. of samples > PEL[2]	no. of samples > PEL[2]
Cadmium	11 of 81	2.10	2.50	2.54	3.53	1	1.2%
Copper	45 of 81	10.2	3.6	17.9	197	0	0.0%
Lead	37 of 81	18.7	6.3	27.4	91.3	3	3.7%
Zinc	81 of 81	61.6	42.2	62.4	315	1	1.2%

[1] Non-detects are considered as 1/2 of the Reporting Limit for calculations of average, median and standard deviation.

[2] PEL = Probable Effects Level

A review of the available sediment metal chemistry data indicate that accumulation of metals above potentially harmful concentrations is unlikely. Additionally, metals are expected to continuously partition out of the dissolved phase and settle out of the water column with particulate organic matter. Residence time in the creek is likely less than one year because each season's major storms will effectively remove any metals accumulated in the creek sediment and transport them downstream to San Diego Bay.[14] Therefore, this TMDL will focus on water column concentrations of dissolved metals.

3.6. Sampling History in the Watershed

Stormwater monitoring of Chollas Creek began in the 1993-94 rainy season under the MS4 stormwater order in effect at that time. Each rainy season, stormwater samples are collected from two or three storms at a station located on the north fork of Chollas Creek near the intersection of 33rd and Durant Streets. To avoid tidal influence, the monitoring station is installed on the north fork above the north and south fork confluence. Runoff from approximately 57 percent of the entire watershed is sampled at the monitoring site (URS Greiner Woodward Clyde 1999). This station samples run-off that is representative of the entire watershed because the land use distribution in the north fork portion of the watershed is nearly identical to the land use distribution of the entire watershed as shown in Table 3.5 below.

TABLE 3.5. Land use distribution for Chollas Creek Watershed.
(URS Greiner Woodward Clyde 1999)

Land Use	Percent of Total Acreage (Entire Watershed)	Percent of Sampled Acreage (North Fork Watershed)
Residential	67%	62%
Commercial	5%	9%
Industrial	7%	10%
Open Space	16%	14%
Roadways	4%	5%

Since the 1993-94 rainy season, stormwater samples have been analyzed for general physical constituents, nutrients, biochemical oxygen demand, chemical oxygen demand, bacteriological constituents, organic constituents and total recoverable metals. Since 2000, samples have also been analyzed for dissolved metals. Toxicity testing began with the 1994-95 rainy season and is conducted using the water flea *Ceriodaphnia dubia* and the fish commonly known as a fathead minnow (*Pimephales promelas*). Toxicity as indicated by mortality was found in every test run on the water flea for the municipal stormwater program. Reproduction of the water flea was generally not impaired. Toxicity was generally not found in tests run on the fathead minnow, but frequently some inhibition of growth was found.

The Regional Board, the California Department of Transportation (CalTrans), the Southern California Coastal Water Research Project (SCCWRP) and the Department of Pesticide Regulation (DPR) have also conducted metals sampling and analysis in the Chollas Creek Watershed. Appendix A has a summary of the data used in this TMDL.

[14] The sediment deposited in San Diego Bay will be addressed in the "San Diego Bay Shoreline, near Chollas Creek" TMDL currently under development.

4. NUMERIC TARGETS

When calculating TMDLs, numeric targets are established to ensure that WQOs are met and beneficial uses are protected. The CTR is the basis of the numeric targets. However, because dissolved metals toxicity is a function of hardness, the CTR criteria for copper lead and zinc are expressed as hardness-based equations. The numeric target equations are shown in Table 4.1. This section will discuss why CTR was chosen as the basis for the numeric targets in this TMDL and will discuss the following different factors/variables of the numeric target equations: continuous and maximum criteria concentrations (CCC and CMC), Water-effect Ratios (WER), total-to-dissolved metal conversion factor (CF), hardness and correlation coefficients (m and b, respectively). Newly proposed copper criteria will also be mentioned at the end of this section.

TABLE 4.1. Numeric targets for dissolved metals in Chollas Creek.

Metal	Numeric Target for Acute Conditions: Criteria Maximum Concentration	Numeric Target for Chronic Conditions: Criteria Continuous Concentration
Copper	(1) * (0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(1) * (0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^ [1.273 * ln (hardness) - 1.460]}	(1) * {1.46203 – [0.145712 * ln (hardness)]} * {e^[1.273 * ln (hardness) - 4.705]}
Zinc	(1) * (0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(1) * (0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

Hardness is expressed as milligrams per liter.
Calculated concentrations should have two significant figures [40 CFR 131.38(b)(2)].
The natural log and exponential functions are represented as "ln" and "e," respectively.

The CTR was chosen as the basis for these numeric targets, because it has the most current, defendable WQOs for dissolved copper, lead and zinc concentrations in fresh water (USEPA, 2000a). The Basin Plan (Regional Board, 1994) provides only narrative WQOs for determining allowable concentrations of copper, lead and zinc in Chollas Creek, while the NTR [40 CFR 131.336] is superceded by the CTR when the values presented in the CTR are more stringent than the respective values presented in the NTR. This is the case for copper, lead and zinc. Additionally, the CTR criteria are legally applicable as WQOs in inland surface waters (e.g., Chollas Creek), enclosed bays and estuaries of California for all purposes and programs under the CWA (USEPA, 2000a).

Specifically, the numeric targets for the Chollas Creek TMDLs were set equal to the CTR's hardness-based equations criteria for dissolved copper, lead and zinc (Table 3.1) and are shown below in their simplified forms (Equations 4.1 and 4.2). These equations were derived by USEPA in order to calculate the criteria that a metal concentration must be below in order to protect freshwater aquatic life from toxicity. Therefore by this definition, setting the numeric targets equal to the CTR equations will also ensure that the narrative water quality objectives for toxicity are met in the water column for copper, lead and zinc. In addition, the numeric targets for Chollas Creek do not vary spatially or temporally and thus apply throughout all freshwater portions of Chollas Creek at all times.

EQUATION 4.1: General Criteria Continuous Concentration (CCC)

$$CCC = (WER) * (CF_C) * \{e^{\wedge}[(m_C * \ln hardness) + b_C]\}$$

Where: CCC = Criteria Continuous Concentration
WER = Water-Effect Ratio
CF_C = Conversion Factor for freshwater chronic criteria
m_C = correlation coefficient
b_C = correlation coefficient

The subscript "c" stands for "chronic" and designates a variable in the CCC equation. The natural log and exponential functions are represented as "ln" and "e," respectively [40 CFR 131.38(b)(2)].

EQUATION 4.2: General Criteria Maximum Concentration (CMC)

$$CMC = (WER) * (CF_A) * \{e^{\wedge}[(m_A * \ln hardness) + b_A]\}$$

Where: CCC = Criteria Continuous Concentration
WER = Water-Effect Ratio
CF_A = Conversion Factor for freshwater chronic criteria
m_A = correlation coefficient
b_A = correlation coefficient

The subscript "A" stands for "acute" and designates a variable in the CMC equation. The natural log and exponential functions are represented as "ln" and "e," respectively [40 CFR 131.38(b)(2)].

4.1. Criteria for Maximum and Continuous Concentration

Table 4.1 (above) identifies targets for both chronic and acute conditions: the CCC equation (Equation 4.1) and the CMC equation (Equation 4.2), respectively. The CMC is the highest concentration that will protect aquatic life from acute or short-term effects, such as mortality. In order to protect aquatic life, the one-hour average water column concentration must be below the CMC. Similarly, the CCC is the highest concentration that will protect aquatic life from chronic or long-term effects, such as reduced birth rates. In order to protect aquatic life, the four-day average water column concentration must be below the CCC. Neither the CCC nor the CMC can be exceeded more than once every three years [40 CFR 131.38 (c)(2). For purposes of evaluating if the Numeric Targets have been attained, sample results should be used according to the requirements in Table 4.2.

TABLE 4.2. Requirements for using sample results to evaluate CCCs and CMCs.

1. If only one sample is collected during the time period associated with the Numeric Target (e.g., one-hour average), the single measurement shall be used to determine attainment of the numeric target for the entire time period.
2. The one-hour average shall be the moving arithmetic mean of grab samples over the specified one-hour period.
3. The four-day average shall apply to flow-weighted composite samples for the duration of a storm, or shall be the moving arithmetic mean of flow weighted 24-hour composite samples or grab samples.

4.2. Water-effect Ratio

The WER is a mechanism for developing site-specific criteria by comparing bioavailability and toxicity of a specific pollutant in receiving waters and laboratory waters and is provided as a variable in the concentration criteria equations (Equations 4.1 and 4.2; USEPA, 2000a). A site-specific WER has not been developed for Chollas Creek. In such circumstances, a WER of unity is assumed and used in the equations. Site-specific criteria are discussed in further detail in Appendix H.

4.3. Total-To-Dissolved Metal Conversion Factor

Prior to 2000, metal criteria for the protection of aquatic life were based on total metal concentrations, that is, the concentration of all sized metal fractions in the water column. Since then the USEPA recommends dissolved metal concentrations, or metals in solution, be used for metal criteria, because dissolved metals more closely represent the fraction of metals bioavailable to aquatic organisms than do total metals (USEPA, 2000a). The CTR criteria equations (Equations 4.1 and 4.2) incorporate total-to-dissolved conversion factors (CFs) to account for that fact [40 CFR 131.38 (b)(2)(iv)]. The CFs for each metal, with respect to acute and chronic conditions, are listed in Table 4.3. The CF for lead is a function of hardness. Concern has arisen in the past that non-dissolved metal in the water column, such as particulate metal, could become bioavailable. Although the Federal Register provides good reasons why this should not be a concern, an explicit MOS was applied in this TMDL to address this possibility.

TABLE 4.3. Metal acute and chronic freshwater conversion factors for copper, lead and zinc.

Metal	CF_A	CF_C
Copper	0.960	0.960
Lead	1.46203 – [0.145712 * ln (hardness)]	1.46203 – [0.145712 * ln (hardness)]
Zinc	0.978	0.986

Reference: [40 CFR 131.38(b)(2)].

4.4. Hardness

As discussed above, CTR criteria are based on empirical relationships of toxicity (metal concentrations) to water hardness (Table 4.1). Hardness is defined as the concentration of calcium carbonate ($CaCO_3$) in the water column and has the units of milligram per liter (mg/L). Freshwater aquatic life criteria for certain metals are expressed as a function of hardness because hardness and/or water quality characteristics that are usually correlated with hardness can reduce or increase the toxicities of some metals. Hardness is used as a surrogate for a number of water quality characteristics that affect the toxicity of metals in a variety of ways. Increasing hardness has the effect of decreasing the toxicity of metals. Water quality criteria to protect aquatic life may be calculated at different concentrations of hardness, measured in milligrams per liter as calcium carbonate.

Like many flowing freshwater bodies, Chollas Creek waters exhibit a wide range of hardness levels. Because hardness data to accurately assess this range were limited, hardness was set as a variable in the numeric targets. Consequently, hardness concentrations must be measured at the time of compliance and the criteria subsequently determined using the equations in Table 4.1. Further, because hardness will be determined at the time of compliance and included as a variable in the CTR equation, a more site-specific and temporal-specific numeric target is achieved.

At times when the hardness concentration exceeds 400 mg/L, a value of 400 mg/L will be used for hardness no matter what the extent of the exceedance. This is because the CTR caps the allowable hardness value that can be used to calculate the resulting water quality criteria. As hardness increases, so do the numeric targets. Conversely, decreasing hardness results in decreasing the numeric targets. Without the use of a WER, the maximum hardness value for associated use with the numeric targets is 400 mg/L $CaCO_3$.

4.5. Correlation Coefficients

The last variables are the correlation coefficients (m and b) shown in Equations 4.1 and 4.2. These coefficients are the result of fitting acute freshwater toxicity metal concentration data to hardness in a log-log relationship and are specified for each metal in Table 4.4 below (USEPA, 1985).

TABLE 4.4. Criteria correlation coefficients.

Metal	m_A	b_A	m_C	b_C
Copper	0.9422	-1.700	0.8545	-1.702
Lead	1.273	-1.460	1.273	-4.705
Zinc	0.8473	0.884	0.8473	0.884

Reference: [40 CFR 131.38(b)(2)]

4.6. Newly Proposed Copper Criteria

The USEPA has published a draft document, *2003 Draft Update of Ambient Water Quality Criteria for Copper* (EPA-822-R-03-026), containing updated freshwater and saltwater aquatic life criteria for copper. These criteria revisions are based in part on new data that have become available since the USEPA's last comprehensive criteria updates for copper. In addition to incorporating new data, the freshwater criteria also incorporate the use of the biotic ligand model (BLM) in the criteria derivation procedures (USEPA, 2003).

The proposed freshwater criteria (the CMC and CCC is 2.1 micrograms per liter (µg/L) and 1.3 µg/L, respectively) differ from CTR's current metals criteria primarily with regard to how metal availability to organisms is addressed. As mentioned above, CTR criteria were based on empirical relationships of toxicity to water hardness. The criteria currently being presented use a BLM instead (Di Toro et al. 2001). The BLM is based on the premise that toxicity is related to metal bound to a biotic site (the biotic ligand) and that binding is related to dissolved metal concentrations and complexing ligands in the water.

Because these proposed criteria have not yet been adopted, the Chollas Creek Metals TMDL could not take these criteria into consideration. However, if/when the criteria are adopted the Regional Board can re-evaluate the numeric targets set forth here based on the new criteria.

5. SOURCE ANALYSIS

The source analysis summarizes the major suspected sources of dissolved copper, lead and zinc to the Chollas Creek Watershed. This includes consideration of point sources and nonpoint sources (which include background) and an estimate of their magnitude and location. Metals, such as copper, lead and zinc, enter surface waters from point and nonpoint sources. Point sources typically discharge at specific locations from pipes, outfalls and conveyance channels from municipal wastewater treatment plants, industrial waste treatment facilities and stormwater conveyance systems. Nonpoint sources are diffuse sources that reach receiving waters from different routes of entry and originate from multiple land uses.

For Chollas Creek, essentially all sources (point and nonpoint) come through the stormwater conveyance system that is regulated by WDRs prescribed in Order No. 2001-01. This order regulates discharges to surface waters from municipal separate storm sewer systems (MS4s) in San Diego County. MS4 discharges are collectively considered to be point sources of urban runoff discharges due to their release from channelized, discrete conveyance pipe systems and outfalls. Because there are currently no other known point sources, urban runoff is considered the most significant source of metals to Chollas Creek and will be the main focus of this analysis. In addition, this analysis will detail potential sources of urban runoff from activities outside and inside of the Chollas Creek Watershed boundaries, including atmospheric deposition. Estimates are drawn from several studies conducted outside the watershed as well as modeling results based on land use classifications within the watershed. Broad classes of sources (for example, urban runoff, atmospheric deposition, etc.) and specific individual sources (for example, land uses, cars, etc.) will be discussed.

Specifically, modeling results based on land use category parameters, hydrological characteristics and observed metal concentrations provided estimates of the magnitude of metal loadings (Appendix D). The top two land use categories in Chollas Creek, freeways and commercial/institutional, contribute over 75 percent of the total load for each metal (Figures 5.4, 5.5 and 5.6). Significant sources of all three metals to urban runoff are thought to include automobile operation (especially brake pads and tires) and industries with practices that may expose metals to stormwater. Water supply infrastructure corrosion, pesticide application and atmospheric deposition are also among the identified potential sources.

5.1. Urban Runoff Regulation in Chollas Creek Watershed

Urban runoff discharges from MS4s are a leading cause of receiving water quality impairments in the Chollas Creek Watershed. In addition, a direct linkage has been established between toxicity and stormwater discharges in the watershed (Schiff, 2001). According to Order No. 2001-01 requirements, all entities that share a particular stormwater system are responsible for urban runoff discharges both (1) into their stormwater conveyance system and (2) from their stormwater conveyance system. Order No. 2001-01 for San Diego County names 20 different entities responsible for stormwater discharges in the San Diego Region. Other than the MS4, there are no known direct point source discharges of metals to water bodies in the Chollas Creek Watershed. The small size of the creek's riparian zone and the encroachment of development along the creek make the amount of run-off directly to the creek much smaller than that entering from storm drains. Furthermore, under Order No. 2001-01, the creek itself is considered part of the storm drain system. Therefore, parties named in Order No. 2001-01 are responsible for not only the run-off entering the creek, but also for the water in the creek itself.

5.1.1 Regional Board Order No. 2001-01

In 1990, the USEPA developed rules establishing Phase I of the NPDES stormwater program, designed to prevent harmful pollutants from being washed by urban runoff into MS4s or from being dumped directly into MS4s and then subsequently into local water bodies. Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or more) to implement a urban runoff management program as a means to control polluted discharges from MS4s. Approved urban runoff management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipally owned operations and hazardous waste treatment. More specifically, large and medium operators are required to develop and implement Urban Runoff Management Plans that address, at a minimum, the following elements:

- Structural control maintenance;
- Areas of significant development or redevelopment;
- Roadway runoff management;
- Flood control related to water quality issues;
- Municipally owned operations such as landfills, wastewater treatment plants, etc.;
- Hazardous waste treatment, storage, or disposal sites, etc.;
- Application of pesticides, herbicides and fertilizers;
- Illicit discharge detection and elimination;

- Regulation of sites classified as associated with industrial activity;
- Construction site and post-construction site runoff control; and
- Public education and outreach.

Of the 20 entities identified in Order 2001-01, the cities of San Diego, Lemon Grove, and La Mesa, the County of San Diego, and the Port (Municipal Dischargers) are all in the Chollas Creek Watershed and are responsible for addressing metal water quality concerns for the MS4 in the Chollas Creek Watershed, as applicable. One exception to note is that the Navy has runoff from its community facilities (Naval Base San Diego) in the Chollas Creek Watershed regulated under its industrial discharge WDRs prescribe in Order No. 2002-0169.[15] Order No. 2002-0169 does regulate urban runoff discharges from MS4s, and the facility is not currently regulated under the MS4 WDRs prescribe in Order No. 2001-01. The Navy is expected to be enrolled in the statewide general WDRs prescribed for small MS4s in Order No. 2003-0005-DWQ.[16]

5.1.2 Other Applicable Orders and Regulations

TABLE 4.1 lists other applicable WDR orders in the Chollas Creek Watershed. With respect to the source analysis, these orders regulate activities that may be contributing metals to Chollas Creek through urban runoff. All applicable orders must be made consistent with the load and waste load allocations of this TMDL. In addition, other regulatory agencies may regulate other urban runoff sources, such as atmospheric deposition from industry and auto emissions, domestic water supply and various pesticide applications (sections 5.4.2, 5.4.5 and 5.5.4).

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[15] Order No. R9-2002-0169 NPDES Permit No. CA0109169, *Waste Discharge Requirements for U.S. Navy Naval Base San Diego, San Diego County*.

[16] SWRCB Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

TABLE 5.1. Applicable orders for land use practices in the Chollas Creek Watershed.

Order General Name	Order Number	NPDES Permit Number	Sections
Statewide CalTrans MS4, industrial, construction Stormwater WDRs	99-06-DWQ	CAS 000003	4.5.1, 4.5.3 and 4.5.6
Statewide General Industrial Stormwater WDRs	97-03-DWQ	CAS 000001	4.5.6
Statewide General Construction Stormwater WDRs	99-08-DWQ	CAS 000002	4.5.3
Statewide General Utility Vault and Underground Structures WDRs	2001.11-DWQ	CAG 990002	N/A
Landfill, burnsites - South Chollas Creek WDRs	R9-97-11, Addendum No. 4		4.5.9
Temporary Groundwater Extraction and Discharge to San Diego Bay and Its Tributaries (Dewatering) WDRs	R9-2000-90		N/A

The section in this analysis of which the respective land use practice is discussed is listed beside the order.

Other sources, such as sewage spills and disposal of particular household products (section 5.5.2) are prohibited by law.

5.2. Estimation of Metal Magnitude and Location from Urban Runoff

Multiple sources of copper, lead and zinc contribute to the accumulated metal on the surfaces of the Chollas Creek Watershed. Rainfall events transfer these accumulated metals to Chollas Creek via the MS4 system. Because the relative loads entering Chollas Creek depend on wet or dry weather conditions, an assessment of existing loads requires separate analyses.

5.2.1 Land-use Modeling

Watershed models were developed by Tetra Tech, Inc. (Appendix D) to estimate the magnitude and source land uses of existing annual metal loadings to the Chollas Creek Watershed during both wet and dry weather conditions of a typical year. In addition, loads for a critical year, a year in which extraordinary rain volumes result in a higher mass load contribution, were also estimated. Table 5.2 shows the total estimate (wet and dry weather condition loads added together) for dissolved metal loading for both a typical and a critical year. All concentrations reported in this section are dissolved metals.

TABLE 5.2. Estimated existing total loads for Chollas Creek for both wet and dry weather conditions during a typical and critical year.

	Copper (dissolved) (g/yr)	Lead (dissolved) (g/yr)	Zinc (dissolved) (g/yr)
Typical Year	232,829	194,175	1,327,393
Critical Year	985,241	705,310	5,994,241

Unfortunately, limited data prevented complete utilization of the watershed models. Because the dry weather model simulation of metal concentration could not be properly calibrated and validated, the dry weather portion of the total estimate was calculated based only on the average observed concentrations. In addition, further refinement of both models is needed before results could be used in calculating a mass load allocation for a TMDL. Regardless, the model results quantify land use metal contributions and will be helpful in targeting higher priority subwatersheds and land uses for implementation of the TMDL during wet weather conditions. Further, the data to be collected as part of compliance monitoring for this TMDL will be used to complete the dry weather model as well as further refine the wet weather model. If modeling results warrant, the TMDL estimates could be adjusted as necessary at that time.

5.2.1.1 Urban Runoff from Wet Weather

Estimating wash-off from various land uses is an appropriate way to quantify the primary sources of copper, lead and zinc loading during wet conditions. Runoff volume and metal concentrations from each subwatershed are therefore dependent on build-up and wash-off rates, which differ depending on the subwatershed's land uses (Figures 5.1 and 5.2). The land uses incorporated into the wet weather watershed model are described in Appendix E.

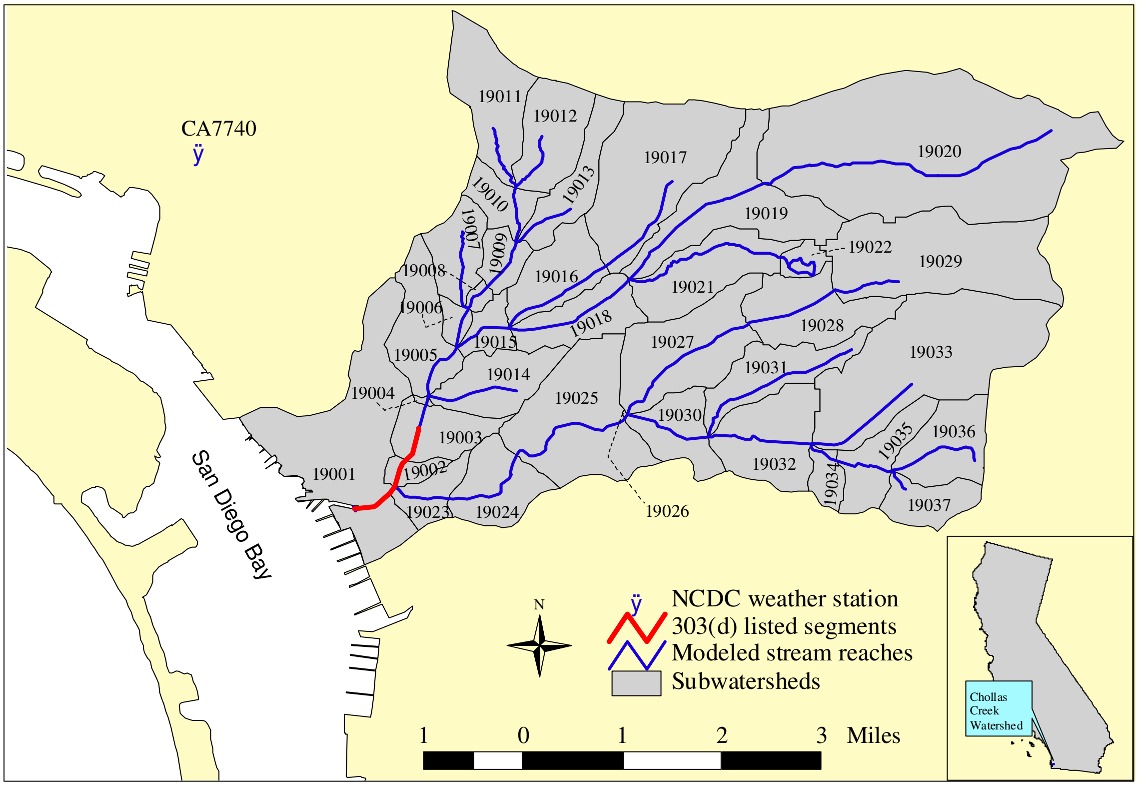

FIGURE 5.1. Chollas Creek Watershed divided into subwatersheds.
(referenced by number)

To estimate total copper, lead and zinc loadings during wet weather events, a watershed model was developed (Appendix D). Hydrology and water quality simulations were performed for 1990 through 2003. Data collected from the San Diego County stormwater programs and other special studies were used to calibrate model outputs (metal loadings) in the watershed. Table 5.3 presents the average annual wet weather load to Chollas Creek (based on model results from 1990-2003) for a typical and critical year. In comparison to the total estimate (Table 5.2), wet weather comprises at least 99.7 percent of the total load for each metal. A critical year was selected in order to understand conditions during maximum flow conditions. For the time period of 1990 through 2003, 1993 was selected as the critical year. This critical wet condition was selected based on the identification of the 93rd percentile of annual rainfall observed at multiple rainfall gages in the San Diego Region during this time period.

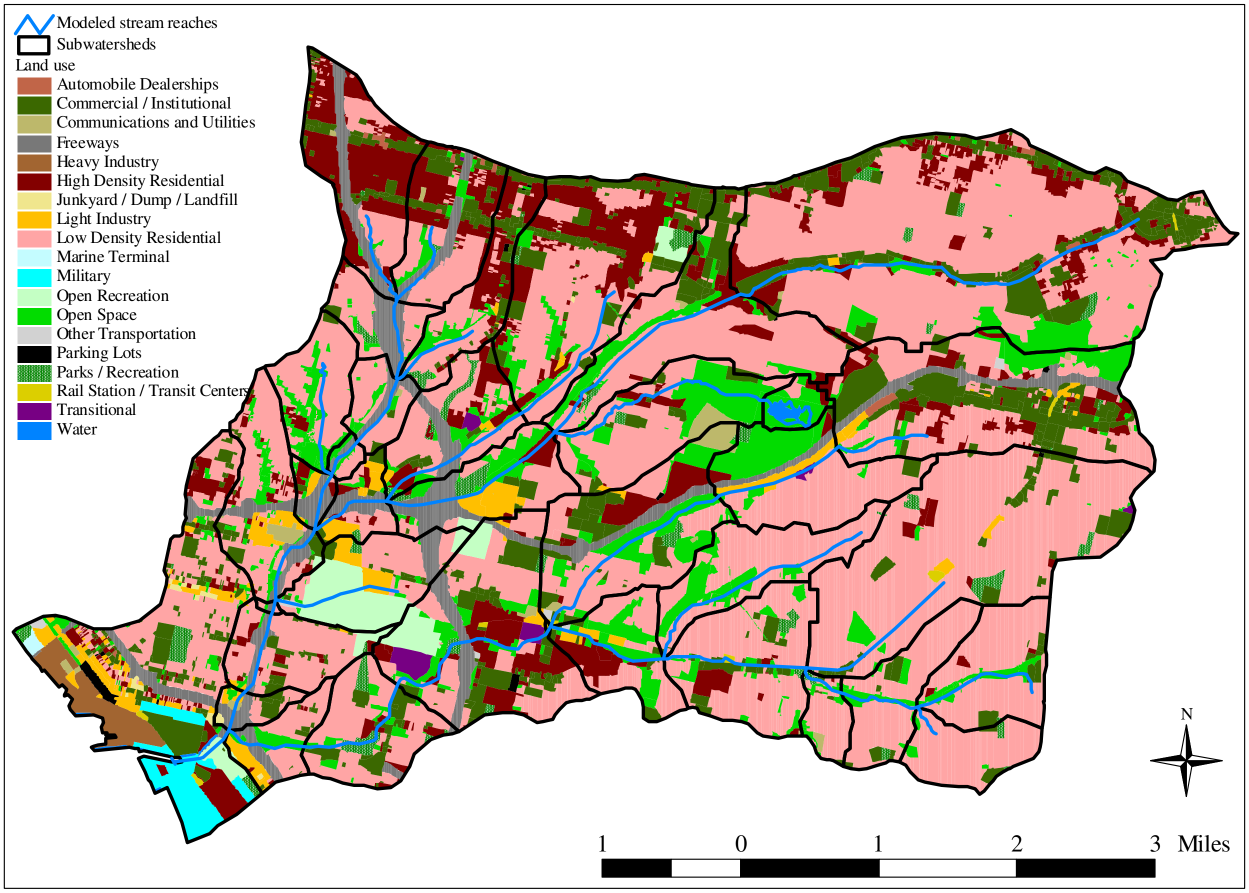

FIGURE 5.2. Land use distribution in the Chollas Creek Watershed.

TABLE 5.3. Estimated existing wet weather total loads for Chollas Creek during a typical and critical year.

	Copper (dissolved) (g/yr)	Lead (dissolved) (g/yr)	Zinc (dissolved) (g/yr)
Typical	232,137	194,007	1,326,407
Critical	984,549	705,142	5,993,255

Because the model estimated loads based on subwatershed characteristics (and hence associated land uses), the location of areas with relatively higher loading can be identified. Figure 5.3 shows annual wet weather loads from the North and South Forks of Chollas Creek. The North Fork contributes a greater pollutant load than the South Fork. These differences are most likely due to the different size and land use distribution of the two drainage areas. For another perspective, Table 5.4 summarizes the top 10 watershed mass load contributors in Chollas Creek for each subwatershed (Figure 5.1).

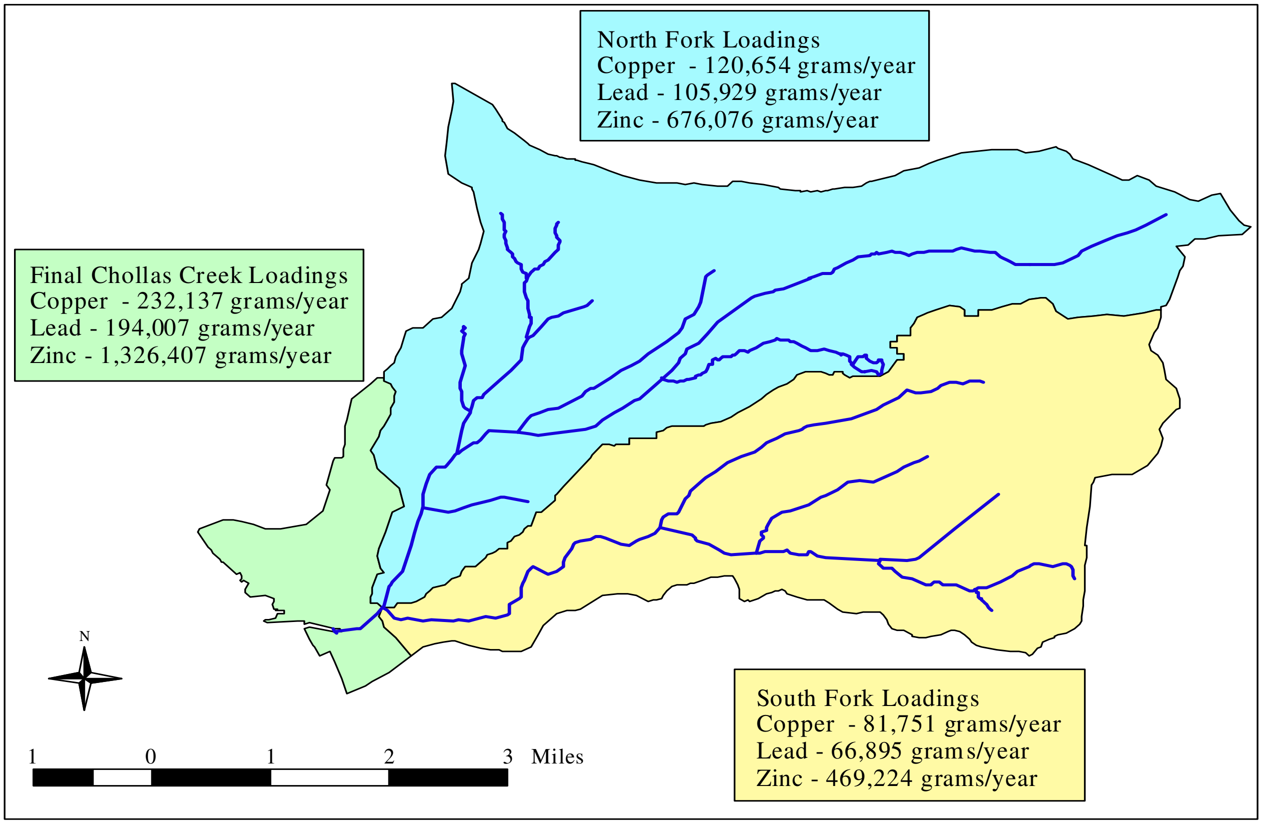

FIGURE 5.3. Average annual wet weather loads for the main branches of the Chollas Creek Watershed.

TABLE 5.4. For each metal, the top ten contributing subwatershed of mass loads relative to all thirty-seven subwatersheds.

Rank	Copper	Lead	Zinc
1	19001*	19001*	19001*
2	19020	19029	19020
3	19029	19020	19029
4	19025	19025	19027
5	19011	19011	19025
6	19027	19027	19011
7	19017	19018	19017
8	19012	19012	19012
9	19018	19017	19018
10	19005	19005	19005

* Subwatershed 19001 was assumed to drain entirely to Chollas Creek, however, portions of the watershed drain to San Diego Bay. Due to the limitations of model set-up, the watershed could only drain either to the Bay or Chollas Creek. The conservative decision was made that all drainage was to Chollas Creek.

Relative basin-wide contributions from each land use are illustrated in Figures 5.4 through 5.6. For all three metals, freeways and commercial/institutional land uses have the highest relative loading contributions; together, these two land uses account for over 75 percent of the metal loadings. Appendix E gives average annual loadings for dissolved copper, lead and zinc (1990 to 2003) with respect to subwatersheds and land uses and also gives subwatershed areas.

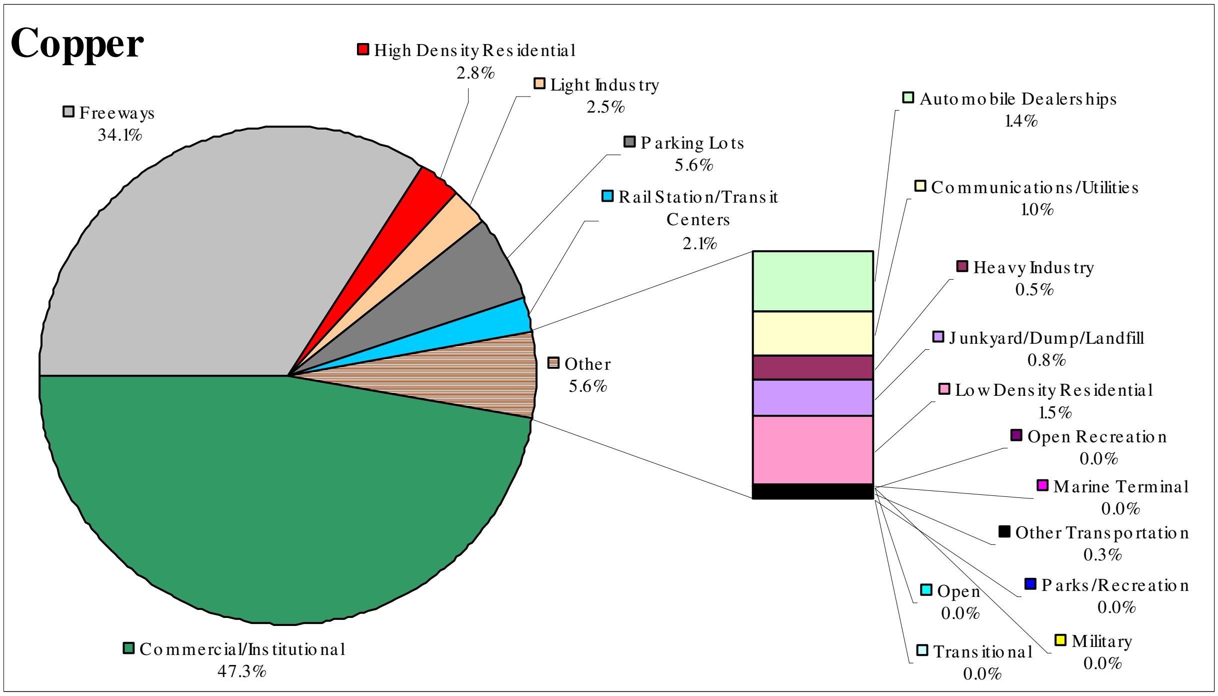

FIGURE 5.4. Basin-wide wet weather copper contributions by land use in the Chollas Creek Watershed.

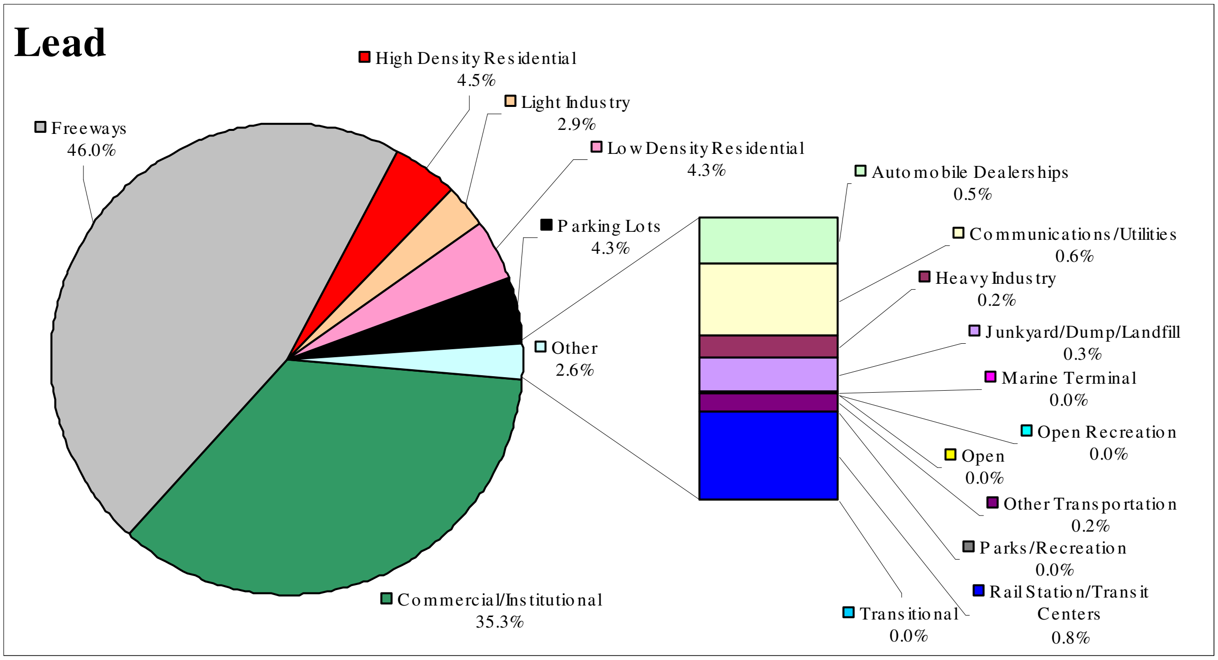

FIGURE 5.5. Basin-wide wet weather lead contributions by land use in the Chollas Creek Watershed.

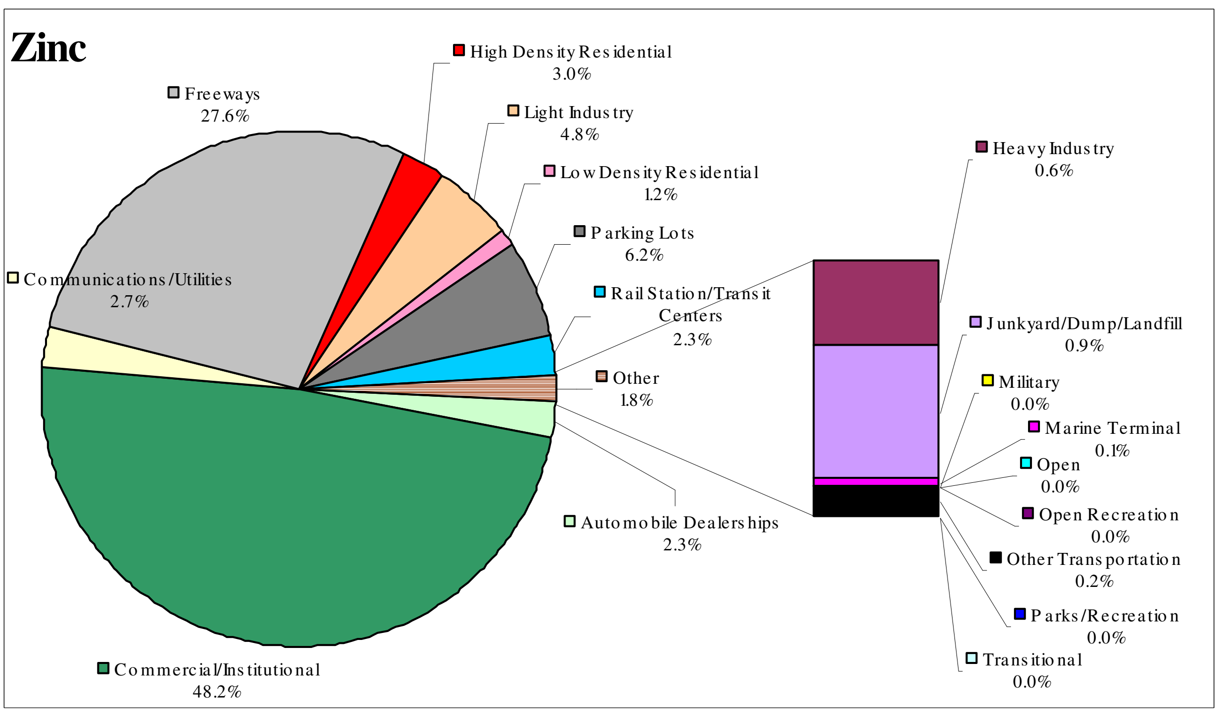

FIGURE 5.6. Basin-wide wet weather zinc contributions by land use in the Chollas Creek Watershed.

5.2.1.2 Urban Runoff from Dry Weather

During dry weather conditions, impaired streams can exhibit a sustained base flow (or urban flow) even if no rainfall has occurred for a significant period to provide runoff or groundwater flows. These flows are generally understood to result from various urban land use practices that cause water to enter storm drains and inland surface waters. Sources of urban flow in Chollas Creek include lawn irrigation runoff, car washing and sidewalk washing. Not only can these urban flows initially contain metals, they may accumulate metals as they travel across lawns and urban surfaces, transporting them to the MS4 system and thus, into Chollas Creek.

To quantify sources from runoff during dry weather, a steady state spreadsheet model was developed to estimate dry weather flow in the watershed (Appendix D). As mentioned before, because limited in-stream dry weather data were available for model calibration and validation, copper, lead and zinc concentrations could not be simulated. Therefore, the simulated flow value was combined with average in-stream dry weather concentrations for dissolved copper, lead and zinc to calculate estimated basin-wide existing loads for each metal (Table 5.5). Since dry weather days were selected based on the criterion that less than 0.2 inches of rain fell during the previous 72 hours, Table 5.5 values also represent the maximum loading (critical condition) during dry weather. Data limitations prohibited the calculation of land use specific loadings and more detailed analyses. Again, the dry weather contributions for each metal comprise at most 0.3 percent of the total estimated existing annual load (Table 5.2).

TABLE 5.5. Existing dry weather load (grams per year) for both typical and critical years.

Copper (dissolved)	Lead (dissolved)	Zinc (dissolved)
692	168	986

5.2.1.3 Discrepancies from Stormwater Monitoring Reports

The San Diego County dischargers regulated under Order No. 2001-01 (Stormwater WDR Order) are required to send in annual Stormwater Monitoring Reports containing estimates of existing metal loads from watersheds through out San Diego County, including the Chollas Creek Watershed. The method used to estimate existing metal loads in these annual monitoring reports is different than the modeling method used by Tetra Tech, Inc. for this Chollas Creek Metals TMDL project; thus, different existing metal loads are estimated from each method.

The modeling method used by Tetra Tech, Inc. incorporates a dynamic calculation of loads based on accumulated pollutants during antecedent dry conditions, amount of pollutants washed off during a rainfall event and the flow resulting from rainfall events. The Stormwater Monitoring Reports currently uses a spreadsheet to calculate loads by first estimating flow volumes based on precipitation and estimating EMCs from local monitoring and literature values. Comparatively, the modeling included a more detailed representation of the Chollas Creek Watershed, including current land use coverage, delineated subwatersheds, soil layers and 14 years of local rainfall data, which captured a wide range of meteorological conditions.

The most likely significant difference between the approaches is the land use coverage. For instance, determining how land use impacted the loads in the spreadsheet model was difficult, because specifics were not provided in Annual Reports on the land uses draining to the mass emissions stations or how this influenced the EMC calculation. Furthermore, in order to take into account recent changes in regional land uses, the most current data were needed to populate the model (LSPC used the 2000 SANDAG coverage; Stormwater Monitoring Reports used 1990 SANDAG coverage). For these reasons, the Stormwater Monitoring Report estimates are considered less robust than the modeling estimates.

5.3. Urban Runoff Studies in Other Watersheds

Many studies have been done worldwide to identify the sources of metals in urban runoff, including several studies in California, although there is minimal information available specifically for San Diego. In this section, the general conclusions of some of these studies, applicable to Chollas Creek, are presented. The main purpose is to provide information regarding potential individual sources of metals in urban runoff and the relative contribution of each of the potential sources. This information is not intended to quantify existing loads. In later sections these studies will be referred to as support of more specific metal contributions to urban runoff from outside and inside the Chollas Creek Watershed.

5.3.1 Santa Clara Valley Study

The various sources of metals in an urban watershed were detailed in a 1992 study in Santa Clara Valley (SCV study; Woodward Clyde, 1994), an urban center located in the San Jose area near San Francisco, California. In 1997 the SCV study results were largely modified to include several more years of water quality data (Woodward-Clyde, 1997). Specifically the SCV study was performed to identify major sources of metals found in the South San Francisco Bay. Major sources of several metals, including copper, lead and zinc, were identified and a percentage of the total annual load for each metal was attributed to each major source.

An investigation of similar detail to the SCV study has not been performed in the San Diego area. However, since both San Diego and Santa Clara are large urban centers on the west coast, some general knowledge from the SCV study can be applied to Chollas Creek. Furthermore, the SCV study estimated the nearly same magnitude of metal load per acre as did the Chollas Creek Watershed model: copper was 0.030 and 0.033 pounds per acre (lb/acre), respectively; lead was 0.026 and 0.032 lb/acre, respectively; and zinc was 0.155 and 0.186, respectively.[17] Table 5.6 list sources that comprised the top five sources of loading to South San Francisco Bay for each metal.

[17] Chollas Creek has an estimated 16,000 acres. The area draining to South San Francisco Bay has an estimated 298,000 acres. The estimate from Chollas Creek was converted to total metal concentrations by conversion factors 0.96, 0.791 and 0.978, for copper, lead and zinc, respectively.

TABLE 5.6. Top five metal sources in urban runoff, in decreasing order
(SCV, 1997)

Constituent	Top Metal Sources
Copper	Brake pads, POTWs*, Natural erosion, Reservoir releases, Water supply/corrosion
Lead	Tailpipe emissions, Natural erosion, Brake pads, Reservoir releases, POTWs
Zinc	POTWs, Tires, Natural erosion, Industry with metal processes, Brake pads

*POTWs – publicly owned treatment works.

Publicly owned treatment works (POTWs) were the only identified point sources in the SCV study. All other sources were considered nonpoint sources. It is important to emphasize that POTWs, or any other point sources besides the MS4, are not present in the Chollas Creek Watershed. The Chollas Creek source analysis and the SCV study also differ in that there are no reservoirs used for potable water in the Chollas Creek Watershed. Figures 5.7 through 5.9 show the relative amounts of copper, lead and zinc contributions for the SCV study when sources from POTWs and reservoir releases are not considered. Automotive sources are thought to be a significant source of all three metals, including brake pads, tailpipe emissions and tire-wear. Industries that have processes that expose metal to stormwater, water supply and corrosion and illegal dumping, especially of motor oil, are also sources that should be mitigated to help lower metal sources to Chollas Creek.

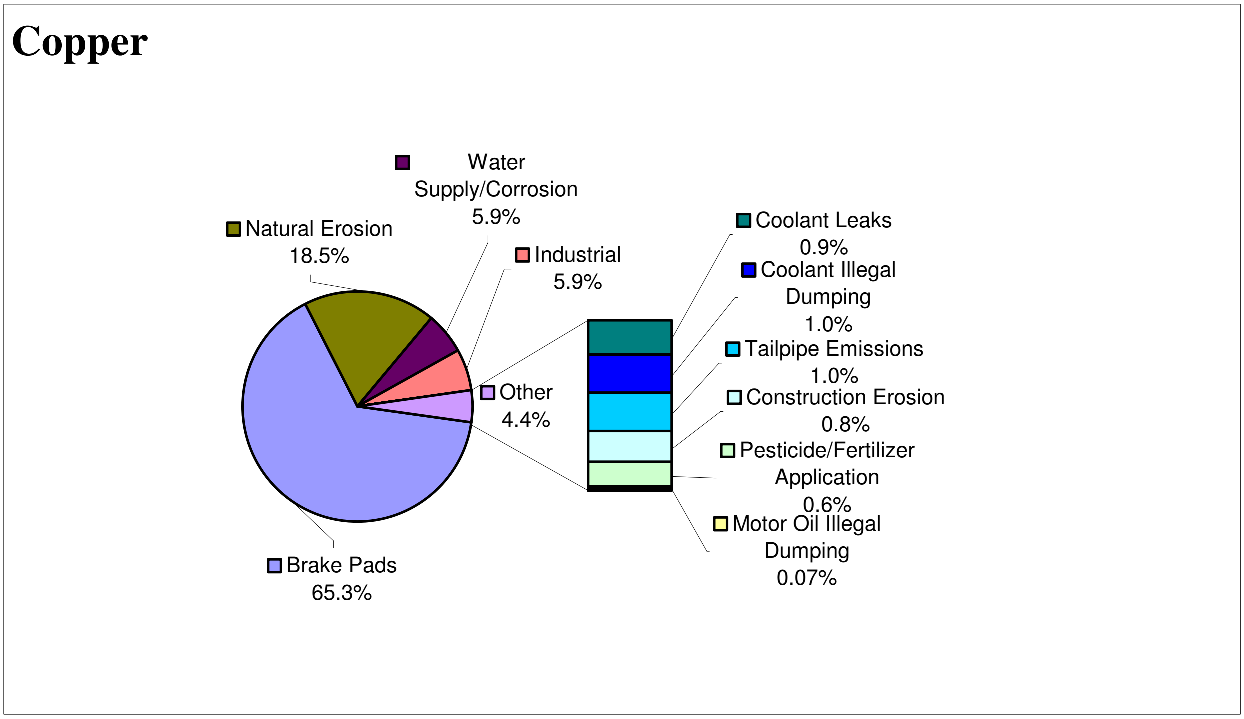

FIGURE 5.7. Relative amounts of copper loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

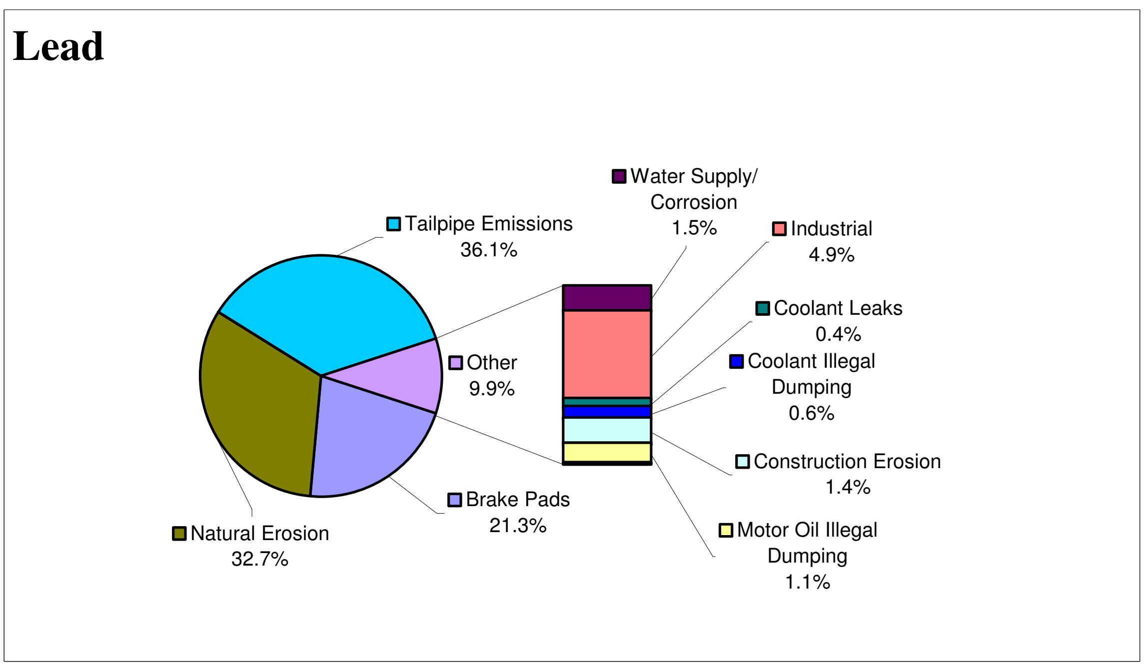

FIGURE 5.8. Relative amounts of lead loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

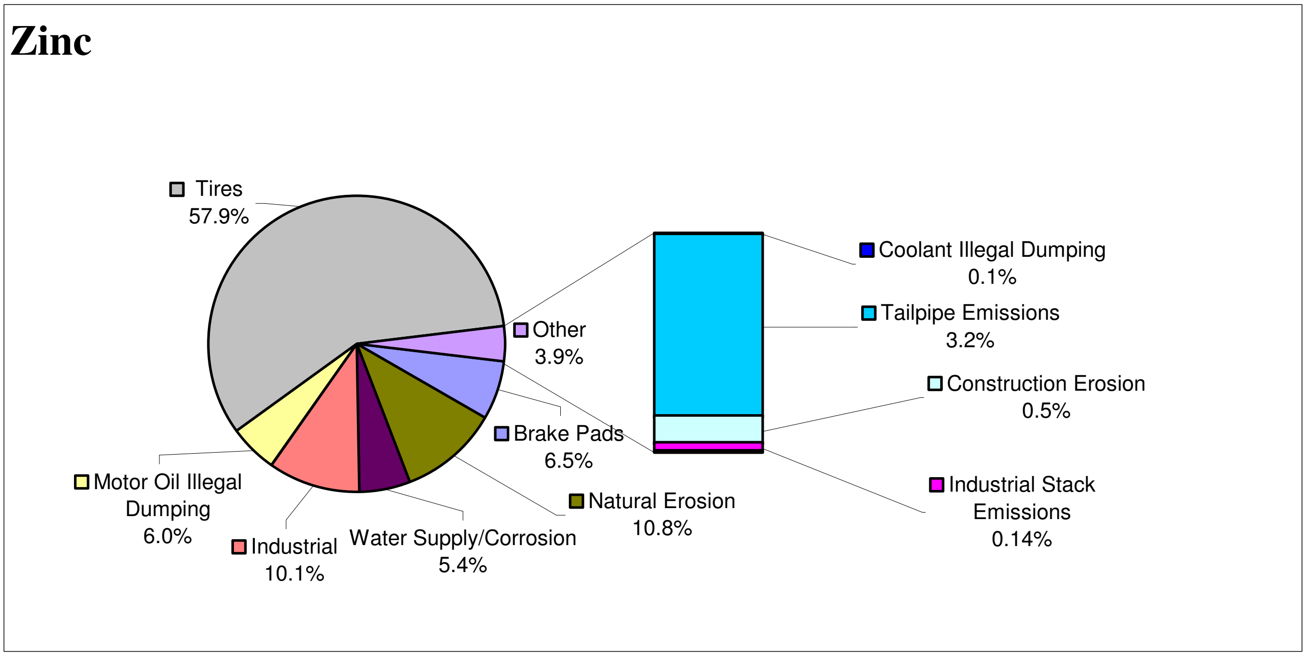

FIGURE 5.9. Relative amounts of zinc loading in SCV, adjusted to omit sources from POTWs, reservoir releases and natural erosion. (Woodward Clyde, 1997)

5.3.2 Other Studies

In addition to the SCV study, other studies in urban areas, although less extensive, have also identified many of the same sources of metals in urban runoff, further confirming them as potential sources in Chollas Creek. The USEPA (1993) and Sansalone, et al. (1997) listed many of the sources identified in the SCV study as well as new ones. Table 5.7 summarizes the following sources of copper, lead and zinc in urban runoff (USEPA 1993; Sansalone, et al. 1997). Furthermore, Muschack (1990) identified metal sources in urban runoff from Germany that included automotive exhaust gases, tire abrasion particles, brake lining abrasion dust, lubricating oils and greases and abrasion of roadways. Also, investigations in Fresno (Brown and Caldwell, 1984) and in Santa Monica (Stolzenbach, et al. 2001), California, researched the deposition rates of atmospheric metal loads from industrial and tailpipe emissions as sources.

TABLE 5.7. Anthropogenic constituents in runoff from urban pavement.
(modified from USEPA 1993**)**

Constituent	Primary Source
Copper	Metal plating, bearing and bushing wear, moving engine parts, brake lining wear, fungicides, insecticides
Lead	Automotive emissions, tire wear (lead oxide filler material), lubricating oil and grease, bearing wear, brake lining wear, engine wear
Zinc	Tire wear (filler material and accelerator in vulcanization process as zinc oxide 0.73%), motor oil (stabilizing additive), grease, metal plating erosion, engine wear

Source: (USEPA, 1993)

Again, general conclusions about metal sources in Chollas Creek can be made based on the similarity of the identified sources of metals in urban runoff from different areas as shown in the studies discussed above: if the major sources of metals in urban runoff were similar for different urban areas a reasonable assumption is that the same sources are present in the Chollas Creek Watershed as well. More information is needed to confirm this assumption or to quantify the amount of contributions from the different sources. The next two sections discuss potential sources from both outside and inside the Chollas Creek Watershed and confirm that many of the sources of metals in urban runoff seen in other urban areas are present in the Chollas Creek Watershed.

5.4. General Urban Runoff Sources: Background, Anthropogenic and Water Supply

The previous section identified various sources that can contribute metals[18] to urban runoff. Obviously, most of these sources cannot be pinpointed to a specific model land use category found in Section 4.2. Most sources can be ascribed to numerous land use practices and even to activity found throughout the area that encompasses a watershed. For example, atmospheric deposition may be from cars driving throughout the Chollas Creek Watershed, from equipment operating at industrial facilities within the Chollas Creek Watershed and from industrial stack emissions from facilities outside of the Chollas Creek Watershed. The sources that are found throughout the regional area are addressed in this section: background, atmospheric deposition, groundwater, sediment and water supply. Background, as defined in this report, is solely the natural level of metals that would go to Chollas Creek without any influence from humans and because of this, background can also be considered a portion of the four other categories. Anthropogenic sources, as defined in this report, are from human activities throughout an area that cannot be pinpointed to a certain area, or in this case the Chollas Creek Watershed. Also, water supply is addressed in this section, because the water supply for the Chollas Creek Watershed comes from outside sources.

These categorized sources most likely enter Chollas Creek directly or indirectly through the MS4 system. As mentioned before, nonpoint sources to Chollas Creek would most likely enter through the MS4 system and thus, would be considered a point source. Because of this and lack of data to prove otherwise, any nonpoint source that goes directly into Chollas Creek is assumed to be comparatively insignificant. Data limitation also prevents any specific estimation of loading from these sources. Direct atmospheric deposition may be revealed as a significant source once data become available. However, other urban runoff studies have made some estimates that may provide insight into these potential nonpoint sources. The model-estimates, in a general way, capture these sources because initial land use parameters were developed from other urban studies with similar anthropogenic sources. Furthermore, the model was calibrated to observed metal concentrations in Chollas Creek, which would inherently account for all anthropogenic sources.

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[18] All measurements are of total metals, unless otherwise denoted as dissolved metals. TABLE 4.3 provides appropriate total to dissolved conversion factors.

5.4.1 Background

Metals occur naturally and cycle by biogeochemical processes throughout the environment. Consequently, of the total metals that may be present in Chollas Creek, a fraction are likely to be from natural sources. There are no background data available for Chollas Creek and an actual quantification of background is not possible given the currently available data. However, model estimates and local reservoir data were examined in order to try to get some insight on natural background sources in the Chollas Creek Watershed.

Generally speaking, open space land uses are assumed to represent natural states of slope and vegetative cover and surface runoff from open space could account for background sources of metals. Approximately 9.73 percent of the Chollas Creek Watershed is designated as open space; however, this area likely does not represent a pristine land use. Surrounding development, urban-sourced atmospheric deposition, prior grading and non-native and invasive species all are likely to effect metal build-up and wash-off rates and surface water infiltration rates in these open spaces. Influences like these should increase metal export rates by increasing metal build-up and surface water velocity and thus, would result in higher metal concentrations than natural background. However, even with these influences, the model estimated the potential load of each metal from the open space land use to be 0.0 percent of the total existing load for each metal. According to the model, the relative contribution of metals from open space land use and thus from background, appears to be insignificant in comparison to loadings from other land uses.

Because data do not exist to determine actual background metal concentrations in Chollas Creek, data from a local reservoir were reviewed. Depending on their location and the source of water, reservoirs should theoretically contain close to background concentrations of heavy metals, because they collect surface runoff. Total metal concentrations were obtained from the City of San Diego Water Department for the Morena Reservoir between 1997 and 2003. The Morena Reservoir was chosen because it does not receive imported water and its watershed, the Cottonwood watershed, is a mainly undeveloped watershed: approximately 90% is undeveloped, 1% is residential and 8% is the Cleveland National Forest (City of San Diego, 2003). The average concentration for copper, lead and zinc was 4.0 µg/L, 1.3 µg/L and 3.1 µg/L, respectively. Further, removing an outlier of 61.7 µg/L in the year 2000 from the data set, the average copper concentration is 1.65 µg/L.[19] These concentrations represent the initial metal load available to a treatment plant and subsequently to the Chollas Creek Watershed.

5.4.2 Atmospheric Deposition

Atmospheric deposition is another potential source of metals to Chollas Creek. Atmospheric emissions from both stationary point sources (e.g. industrial) and mobile sources, including emissions from both diesel-fueled and unleaded-fueled vehicles, enter the water bodies via direct and indirect deposition. These emissions affect rainfall and also cause settling of particulates during dry weather (Woodward-Clyde, 1992). Direct atmospheric deposition results from both wet and dry deposition directly to the surface of

[19] Nondetects were considered as on half of the DL for statistical purposes.

the water body. Indirect atmospheric deposition occurs when dissolved metals enter the watershed that drains to Chollas Creek and is therefore a component of urban runoff carried by the MS4. Topographic characteristics make indirect deposition the major component of atmospheric sources, relative to the direct deposition that may land on the surface area of Chollas Creek. Some information on atmospheric deposition follows from other urban studies. However, more site-specific information is needed to properly quantify either the direct or indirect deposition. If data are available at a future time, they may be used to further refine this analysis.

Atmospheric deposition rates of trace metals have been investigated in limited studies in California. In one Southern California study, atmospheric deposition of metals was calculated for Santa Monica Bay and the Santa Monica Bay watershed (Stolzenbach et al., 2001). Copper, lead and zinc atmospheric deposition rates were determined through a combination of direct and indirect methods to determine contaminant loading. Researchers found that atmospheric deposition, primarily through daily dry deposition, was a significant contributor of nonpoint source pollutant loading to Santa Monica Bay.

The SCV study, previously discussed, also evaluated contributions of copper, lead and zinc due to atmospheric emissions of particulates both from stationary and mobile sources. The study found that atmospheric emissions of copper from vehicle exhaust was largely due to diesel-fueled vehicles (Woodward-Clyde 1992) and was approximately 1% of the total copper load. Also, the SCV study found the largest source of lead was from tailpipe emissions and that, although it was not a top zinc source, atmospheric emissions of zinc in SCV from vehicle exhaust were largely due to both diesel fuel and unleaded fuel exhaust (Woodward-Clyde 1992). Zinc was also the only metal of the three that had industrial stack emissions as a source.

Deposition rates determined for Fresno, California may give a rough understanding of atmospheric lead loads to Chollas Creek. The dry weather lead deposition rate for Fresno was obtained from studies by the National Urban Runoff Program (NURP) and determined to be 2.22 milligrams per meter squared per month for lead (Brown and Caldwell 1984). If these results were directly applied to the Chollas Creek Watershed,[20] roughly 1,740,000 g/year total metals would be the estimated load. However, this value should only be used for an illustrative purpose: Fresno and San Diego differ in climate, population, etc. Also, the reformulated gasoline (RFG) program and the Clean Air Act as amended in 1990 have since prohibited the introduction of gasoline containing lead or lead additives for commercial use as a motor vehicle fuel. The latter point suggests the lead deposition is less now than in 1984.

In fact, since the SCV and Fresno studies were performed, the USEPA has implemented the RFG program in 17 cities across the country, including San Diego, to reduce emissions of toxic pollutants (including metals) and smog forming pollutants from automobiles. Phase I of the RFG program was implemented in 1995 and Phase II began January 1, 2000. The State of California implemented its own RFG program effective in 1996 that met USEPA's Phase II requirements. Therefore, metal emissions from

[20] The Chollas Creek Watershed is estimated to be 6.59 x 10^7 meters squared.

automobiles are expected to be less than those determined in the SCV and Fresno studies, but emissions will not decrease further with the recent implementation of Phase II since California has been meeting the Phase II requirements since 1996. Although the RFG program does not impact diesel fuel, which contributes the largest amount of metals, the effects of the program may still be measurable.

Again, because information on atmospheric deposition of metals to the San Diego Region is not currently available, more research is needed to characterize this source of loading. Perhaps in the future the model developed for Santa Monica Bay (Stolzenbach *et al.,* 2001) could be adapted to local conditions and combined with atmospheric concentrations of metals for San Diego County. At this time however, a reasonable assumption is that Chollas Creek receives significant amounts of copper, lead and zinc from indirect deposition. These sources must travel through the MS4 to reach Chollas Creek and thus have already been accounted for. On the other hand, direct atmospheric deposition of metals is assumed to be relatively insignificant to Chollas Creek compared to other sources, in part due to the small surface area of the creek.

5.4.3 Sediment

Chollas Creek sediment likely contains metals that could become a source in a more static system. However, Chollas Creek is a highly dynamic system that ranges from low flow (dry) during the summer to high velocity and high volume flows during and shortly after storm conditions. This leads to short residence times for any sediment and associated metals within the creek. The available data support this idea (see Problem Statement). Therefore, sediment is assumed to not reside in Chollas Creek long enough to allow metal concentrations to build to high enough levels that the sediment becomes a source to the creek.

5.4.4 Groundwater

Groundwater flows may be another source of metals to Chollas Creek. Subterranean flows may seep directly through the creek bed or surface at other points within the watershed. There are portions of Chollas Creek that are lined with concrete that forms a barrier to groundwater flow into the creek. Also there are portions of Chollas Creek were water is present even during long periods of dry weather. However, groundwater flows and their contribution to Chollas Creek are poorly characterized. Until further information is available, groundwater contributions directly to the creek bed are assumed to be a relatively insignificant source of metals.

5.4.5 Water Supply

In the San Diego Region sparse rainfall requires that approximately 90 percent of water demand be met with imported water, mostly from the Colorado River. The remainder of the water supply comes from treated runoff that is collected in reservoirs (City of San Diego, 2004). In the Chollas Creek Watershed, supply water is transported in from two treatment plants (Alvarado and Otay), which process water directly from reservoirs Murray, San Vicente, El Capitan and Otay. (None of which are located in the Chollas Creek Watershed.) The SCV study concluded that water supply was a metal source for copper, lead and zinc, which included corrosion inhibitors, algae inhibitors and corrosion of distribution infrastructure. These sources will be discussed in this subsection as they apply to Chollas Creek.

To summarize the SCV study, several pathways were found through which tap water can eventually reach surface and ground waters, including car washing, irrigation, building and sidewalk cleaning, system overflows and hydrant flushing (Woodward-Clyde 1997). The study also estimated the amount of tap water that potentially reaches surface and ground waters and multiplied that amount by the estimated concentration of metal in tap water. Copper in the water supply was attributed to both the amount found in the source water (largely influenced by algaecide application) as well as the amount that leached into the potable water from corrosion of copper piping. Also, a large portion of the zinc loading from water was attributed to the addition of zinc orthophosphate, a corrosion inhibitor, to potable water. Other sources of zinc from the water supply included corrosion of plumbing and source water. Reservoir releases were also a significant source of all three metals in the SCV study.

5.4.5.1 Reservoir Contributions – Releases and Algaecide

There are no drinking water reservoirs within the Chollas Creek Watershed. The Chollas Reservoir is no longer an active drinking supply and drains such a small watershed that overflows seem unlikely. Furthermore, the lake is maintained at a level to prevent spills; only normal leakage from the dam into a nearby canyon occurs to prevent the dam from breaking. No spills have been recorded since the concrete dam was built several decades ago (Chaffin pers. comm., January 2005). Therefore, reservoir releases are not considered a significant source of copper in Chollas Creek.

The algaecide copper sulfate, a potential source of copper, is applied infrequently and in small, strategic amounts in Metropolitan Water District (MWD) reservoirs (Wang pers. comm., January 2005), minimizing the amount of copper in the potable water supply from the MWD. In San Diego, no copper sulfate has been added to any of the reservoirs in the last five years except for the Miramar Reservoir, which is not located in the Chollas Creek Watershed and does not supply the plant that services the Chollas Creek Watershed population. Further, either the Alvarado or Otay Treatment Plants would treat the reservoir water before it would reach the Chollas Creek Watershed. Therefore algaecides used in the potable water supply in San Diego are assumed not to be a significant source of copper.

5.4.5.2 Treatment Plant Contributions and Corrosion Inhibitors

The San Diego Water Department does not add any corrosion inhibitors that contain heavy metals to the water supply; only sodium hydroxide is added for pH control (Chaffin pers. comm., January 2005). The pH is maintained at 8.2, which results in the water being slightly scale forming, thus reducing the amount of heavy metal corrosion in the piping. Therefore corrosion inhibitors used in the potable water supply in San Diego are assumed not to be a significant source of zinc.

The MWD, which manages the three San Diego plants including Alvarado and Otay, indicated that its effluent water generally has copper concentrations below the detection limit of 10 micrograms per liter (µg/L) (Wang pers. comm., January 2005). In addition, in 2003 the City of San Diego reported (City of San Diego, 2003) low average concentrations of copper, lead and zinc (Table 5.8).

TABLE 5.8. Average metal concentration of treatment plant effluent in 2003.

Treatment Plant	Copper (µg/L)	Lead (µg/L)	Zinc (µg/L)
Alvarado	3.9	<2	<8
Otay	ND	<2	<8

Because the treatment plants' effluents have little detectable copper, lead and zinc, it is concluded that water supply, up to the time it leaves the plant as effluent, is an insignificant contributor of these metals to the Chollas Creek Watershed.

5.4.5.3 Infrastructure Contributors – Water Supply from "Tap"

Corrosion of copper piping in San Diego, however, is considered a significant source of copper. In 1999 the City of San Diego performed a lead and copper household monitoring study on more than fifty homes, to measure copper and lead concentrations in household tap water (Brannian, pers. comm., July 2000). The first liter of tap water collected was after six to twelve hours of non-use of household water. The average copper concentration for the homes was 180.7 µg/L and the average lead concentration from household taps was 2.6 µg/L. Since the copper concentrations coming from the three plants are below 50 µg/L and more likely near 10 µg/L since MWD effluent is at that level, copper plumbing corrosion in residential homes seems to add a relatively significant amount of copper, 130 µg/L to 170 µg/L, to the potable water supply. Conversely, lead concentrations coming from the three plants are below 5 µg/L and lead sources due to plumbing corrosion, seem to be very insignificant if any at all. Also, the City of San Diego does not use lead piping in its utilities, except for plumbing fixtures (City of San Diego, 2004). No results from the 1999 household monitoring study are currently available for zinc. However, more recently the 2002 City of San Diego Water Department Consumer Confidence Report (City of San Diego, 2002) reported copper sampling results at 0.346 milligrams per liter (mg/L) or 346 µg/L, lead sampling results at less that 5 µg/L and zinc sampling results at less than 50 µg/L. The 346 µg/L copper level was reported as the 90th percentile concentration.

For illustrative purposes, consider typical per capita water usage to be 65 gallons per day (Metcalf and Eddy 1991). If the population of the watershed was roughly 300,000 (SANDAG, 1999), the total water usage in the watershed would be about 20 million gallons per day (MGD). Approximately 50 percent (10 MGD) of water used will reach the wastewater system and of the remaining amount, 10 percent will reach the creek (1.0 MGD) (Woodward Clyde 1992). Since corrosion of copper piping contributes roughly 170 µg/L of copper (the more conservative estimate) and 2.6 µg/L of lead to the water supply, this source contributes approximately 235,000 g/year (100 percent of the modeled typical year) and 3,600 g/year (2 percent of the modeled typical year) to the Chollas Creek Watershed, respectively.

Although this estimate does not exactly match model estimates (likely due to differences in time, inherent uncertainties in methodology and physical interactions when potable water travels across the watershed), it does highlight the fact that a significant amount of copper may be entering Chollas Creek as urban runoff simply from the drinking water supply, which most likely results from piping infrastructure.

5.5. Urban Runoff Sources from Chollas Creek Land Use Activities

This section supplies additional detail on the land use practices that may contribute metals to Chollas Creek. The information here is gathered from the studies mentioned in section 5.3 and can be applicable to different land uses. For example, residential land use sources include application and disposal of household products such as pesticides, fertilizers, paints and maintenance and construction activities, such as remodeling, building and cleaning roofs and gutters. Some of these sources may also result from land uses such as commercial/institutional and open recreation (golf courses/cemeteries). At this time, quantitative data are not readily available to support an estimate of the loads potentially contributed by each of these sources. In the future, if data are available, adjustments to this source analysis could be made. Also, the sources of metals are not limited those listed here. These are sources that, because of other studies, are known to commonly contribute metals to urban runoff.

5.5.1 Operating Automobiles

Automotive sources (other than emissions, which were discussed in section 5.4.2) include maintenance and operation activities for automobiles and trucks, such as wear and tear on tires and brake pads and spills and leaks of fluids such as motor oil, coolants, etc. Copper and zinc are also released through the abrasion of roadways (Muschack 1990).

Brake pad wear is likely a significant urban nonpoint source of copper in Chollas Creek and to a lesser extent a source of lead and zinc. The SCV study calculated that the typical amount of copper released from a single car due to break-pad wear was 7.23 g/26,000 miles (Woodward-Clyde 1992). Brake pad wear may also be a significant source of lead and zinc in urban runoff (Sansalone 1997). Supporting information on how much copper is contained in brakes and brake equipment is also available from the Brake Pad Partnership Program's Brake Manufacturers Council Product Environmental Committee Report. Information on how much copper (or lead and zinc) ends up on the roadways and into stormwater sewers is currently not available (Connick, 2004).

Tire wear was the second largest contributor of zinc in the 1997 SCV study. Woodward-Clyde (1992) also estimated that the typical amount of zinc released per vehicle due to tire wear was 43.04 g/40,000 miles. In addition, Sansalone, et al, also found that tire wear is a potential source of copper and lead in urban runoff (1997). There are currently very limited data on how tire wear affects urban runoff, however the Rubber Manufacturer's Association is currently assisting in the data search for tire-wear emissions.

Also according to the SCV study, copper, lead and zinc are all found in motor oil and coolants for automobiles and can potentially affect urban runoff as leaks, spills or illegal dumping. Motor oil accounts for a larger percentage of zinc's total estimated load than for copper or lead, and although relatively less significant compared to other sources, coolant was an identified source for all three metals. Coolant contains an approximate copper concentration of 76 µg/g and motor oil contains a zinc concentration of 1,060 µg/g (Shaheen 1975). In San Diego, contributions from automotive coolant leaks, coolant dumping, oil dumping and oil leaks were assumed to be less significant relative to other sources since the San Diego and the Santa Clara Valley are similar in demographics.

5.5.2 Illegal Sources

As mentioned above copper, lead and zinc contributions from automotive coolant dumping and oil dumping are possible in the Chollas Creek Watershed. However, this TMDL will not consider allocations for dumping of coolants and motor oil into the MS4 system because dumping is illegal. Similarly, copper, lead and zinc loads periodically occur as a result of sewage spills. All loads from sewage spills (also illegal) are assumed to receive a 100 percent reduction for implementation of the TMDL through the enforcement of existing permits.

5.5.3 Industrial Facilities

Industrial sources may also be a significant source of copper, lead and zinc in Chollas Creek, especially facilities that handle, process, or store metals that may be exposed to rainfall. These facilities would be included in both the heavy industry and light industry land use model categories. The Order No. 2001-01 requirements for San Diego County require municipalities, including the City of San Diego, to identify industries that threaten water quality and to require these facilities to test for and manage pollutants that are likely to reach stormwater. Further, the Industrial Storm Water General NPDES WDRs Order 97-03-DWQ (General Industrial NPDES Requirements) is an order that regulates discharges in Chollas Creek that are associated with ten broad categories of industrial activities.

The 1992 SCV study identified industries with potential to allow metals to enter stormwater discharges and was based on professional knowledge of processes that result in metals being exposed to stormwater. Table 5.9 shows the industries that were prioritized as having the highest likelihood to discharge quantities of metals in stormwater. Because of the similarities between Santa Clara and San Diego, any of the same industries in the Chollas Creek Watershed are likely to be potential metal contributors.

TABLE 5.9. Industries with highest likelihood to discharge metals to stormwater. (SCV, 1992)

Industry	Standard Industrial Classification (SIC) Code
Mining of Miscellaneous Metal Ores	1099
Metal Plating	3471
Boat Building and Repairing	373
Industrial Machinery	355 and 356
Trucking	4212, 4213 and 4214
Metal Scrap Industry	5093
Metal Scrap Industry Combined With Used Auto Parts Sales	5015

Automotive Repair, Include Automobile Renting And Leasing	751, 7538 and 7539
Galvanizing And Metal Coating	3479

Particular industries in the Chollas Creek Watershed that may be contributing a significant amount of metals is the auto wrecking/dismantling facilities and scrap metal recycling facilities (Standard Industrial Classification [SIC] 5015 and 5093, respectively). A report completed by Sustainable Conservation in San Francisco has also identified auto wrecking/dismantling facilities and scrap metal recycling facilities as two industries that contribute metals to stormwater runoff (O'Brien, 2000). A review of discharge reports was conducted for auto wrecking/dismantling shops and scrap metal recycling facilities in the Chollas Creek Watershed and only three of approximately twenty-two facilities tested for copper, lead and zinc in their stormwater runoff. Notably, all three facilities had fairly high concentrations of metals in their discharge. Among the three facilities, copper ranged from 72 to 500 μg/L, lead ranged from 42 to 690 μg/L and zinc ranged from 260 to 1,000 μg/L in runoff from the facilities.

5.5.4 Pesticides

Pesticides were also identified as a potential source of copper and zinc in Chollas Creek, although the SCV study only discussed copper as a source. The 2002 DPR annual report was reviewed for pesticide use in San Diego County. All applications of pesticides that contain copper or zinc are identified and listed in Table 5.10, except for applications that would not correspond with the land uses at Chollas Creek. For example, agricultural pesticide application was not given. Moreover, DPR does not report residential, or nonprofessional, use of pesticides (DPR, 2002) and according to a survey most residents in the Chollas Creek Watershed apply pesticides themselves, as opposed to hiring a professional (Willen, 2002). Only a percentage of the pesticide amount shown in Table 5.10 is actually copper or zinc and there is not enough information to quantify the actual amount of copper or zinc that would reach a water body in the San Diego County. (Chollas Creek is approximately 0.6 percent of the total area in San Diego County.)[21]

[21] The Chollas Creek Watershed is estimated to be about 6.59 x 10^7 meters squared. According to California State Association of Counties in 2002 San Diego County is estimated to be 4,281 square miles.

TABLE 5.10. Pounds of chemicals containing copper and zinc applied in San Diego County in 2002 as reported to DPR.

Active Ingredient of Pesticide	Pounds of Chemical Applied in San Diego County	Active Ingredient of Pesticide	Pounds of Chemical Applied in San Diego County
Copper	5693	Copper 8-Quinolinoleate	10
Copper Ammonium Complex	304	Copper Sulfate (Anhydrous)	0.3
Copper Carbonate, Basic	819	Copper Sulfate (Basic)	20
Copper Ethanolamine Complexes, Mixed	182	Copper Sulfate (Pentahydrate)	2904
Copper Ethlenediamine Complex	14	Zinc Oxide	3366
Copper Hydroxide	6	Zinc Phosphide	66
Copper Naphthenate	1394	Zinc Sulfate	3
Copper Oxide (ous)	376		

Reference: (DPR Website, 2002 Report)
The chart excludes copper and zinc pesticides used in nurseries.

5.5.5 Wood Preservatives

Wood preservatives are actually pesticides that protect wood against attack by fungi, bacteria, or insects. The active ingredients found in wood preservatives may include copper or zinc. Preservatives of this sort are injected into the wood before purchase (pressure-treated wood) or applied by the user. If wood-preservative chemicals are incorporated into a paint or stain, that product is considered a pesticide and is regulated under the DPR. Wood preservatives in residential, commercial and industrial areas could also be a contributor of copper to Chollas Creek

5.5.6 Construction

Construction erosion is a potential source of metals in Chollas Creek. In California, dischargers whose projects disturb one or more acres of soil or whose projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General NPDES WDRs for Discharges of Stormwater Associated with Construction Activity (Construction General NPDES WDRs, Order No. 99-08-DWQ). Construction activities subject to this permit include clearing, grading and disturbances to the ground such as stockpiling or excavation. The Storm Water Construction Notice of Intent (NOI) database can be reviewed at any time to identify current construction projects underway, according to zip code, city and waste disposal identification (WDID) number. The land use percentage of land under development is estimated to be about 0.33% of the Chollas Creek Watershed.

5.5.7 Galvanized Metals

Galvanized chain-link fences may also contribute zinc to urban runoff. There are extensive stretches of chain-link fencing along roadways in the Chollas Creek Watershed. However, there are no known studies on the amount of zinc contributed by fencing. Zinc loads from this potential source would be estimated if relevant data become available at a later date. Also galvanized roofing materials and gutters have been found to contribute 153 µg/L and 363 µg/L of zinc to urban runoff, respectively (Woodward-Clyde, 1992).

5.5.8 Paint

A study conducted in Kentucky by the U.S. Department of Energy (Kszos, et. al., 2004) found that paint used on metal cylinders was causing toxicity to C*eriodaphnia dubia* in stormwater. Further investigation revealed that zinc was the causative agent. Similar paints are likely to be used in the Chollas Creek Watershed and should be considered as a likely source of zinc. Data are currently unavailable to quantify this potential load in the Chollas Creek Watershed. However, the SCV study estimated that residential paints contributed less than 1 percent of the total zinc load. In San Diego, contributions from residential paints are also assumed to be relatively less significant compared to other potential sources since the cities are similar in demographics.

5.5.9 Landfill

Special consideration must be paid to groundwater flows through former and active landfills and any former burn ash areas because of the increased likelihood that these areas may contribute significant amounts of metals to groundwater. There are currently no active landfills in the Chollas Creek Watershed, as indicated by the land use model results, or former burn sites. There is however a closed landfill, South Chollas Landfill, which sits adjacent to and apparently down gradient of, the Chollas Creek Reservoir in subwatershed 19022. The landfill is regulated under General WDR Order No. 97.11[22] and is required to address groundwater contamination concerns.

The landfill was closed in 1981 and annual monitoring data have been available since 1987. Samples were analyzed for copper, lead and zinc, however, only until January 1997. The San Diego Basin Plan does not designate any beneficial uses for the groundwater in the 908.20 hydrologic area. Subsequently, the Basin Plan does not list WQSs applicable to the groundwater under the South Chollas Landfill. Furthermore, since hardness analyses were not performed, comparison of metal concentrations to surface water CTR criteria is not possible. The ultimate fate of groundwater at the most down gradient well at the landfill is unknown. Local geology may bring the water to the surface such that leachate would reach Chollas Creek as surface flow and come under the jurisdiction of the MS4. Also, the Chollas Creek Reservoir may be impacting groundwater through artificial recharge, which has caused higher groundwater levels in the vicinity of the landfill site. Reservoir leakage could be passing through the closed landfill and carrying metals and other pollutants down to the creek. However, the available data do not allow for reservoir leakage to be quantified.

Until further information is available, the South Chollas Landfill and the Chollas Reservoir are considered only as potential sources of metals to Chollas Creek. This designation has no bearing on the load and waste load allocations of this TMDL but is useful information when considering metal loading reduction scenarios. If the landfill is determined to be a source of metals, appropriate corrective actions will be required of the discharger responsible for the landfill to be consistent with the allocations of this TMDL.

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[22] Order No. 97.11, *General Waste Discharge Requirements for Post-Closure Maintenance of Inactive Nonhazardous Waste Landfills within the San Diego Region.*

5.6. Summary of Sources

Modeling efforts (Appendix D) have identified freeways and commercial/ institutional land uses as having the highest relative loading contributions of copper, lead and zinc to Chollas Creek. Together, these two land uses account for over 75% of the predicted metal loadings. The model gives an estimate of the magnitude and location of copper, lead and zinc in the Chollas Creek watered. Additionally, other watershed studies outside Chollas Creek have identified individual sources of copper, lead and zinc likely to be present in the Chollas Creek Watershed, including many aspects of automobile operations, water supply systems, pesticides, industrial metal recyclers and other suspected significant sources to Chollas Creek.

More data are needed to better understand the impacts these suspected sources have on concentrations of copper, lead and zinc in Chollas Creek. Additional information is needed to properly populate the watershed model to more accurately describe dry weather loadings. Local data are also needed to quantify other sources and should be collected under Order No. 2001-01 (as amended) to be consistent with the load and waste load allocations of this TMDL. The Regional Board may also use its authority under the California Water Code to require the collection and reporting of the necessary information. However, the current modeling efforts effectively quantify and identify the land uses that are considered to be the biggest contributors of copper, lead and zinc to Chollas Creek. The land uses and subwatersheds that contribute more than the others may be targeted during implementation planning and load reduction scenarios. Furthermore, the specific suspected sources of metals, as identified in watershed studies from other regions, will be helpful in targeting practices that may be amenable to load reduction scenarios.

6. LINKAGE ANALYSIS

The TMDL technical report must estimate total assimilative capacity (loading capacity) of Chollas Creek for the metals and describe the relationship between Numeric Targets and identified metal sources [40 CFR 130.7 [d] and 40 CFR 130.2 [i] and [f]]. Collectively, these requirements are termed the linkage analysis and provide the necessary quantitative link between the TMDL and attainment of WQSs.

The total assimilative capacity, or loading capacity, is the maximum amount of pollutant that a water body can assimilate while maintaining WQSs. The loading capacity is also a function of different hydrodynamic processes that affect the environmental fate and transport of dissolved metals as they move through the system. At Chollas Creek, the loading capacity for each metal is estimated to be equal to its respective Numeric Target. Per the Numeric Target's basis on CTR (see Numeric Target section), these loading capacities will attain WQSs, because the Numeric Targets are at a minimum to be protective of aquatic life and are thus conservatively considered the total loading capacity for Chollas Creek. Also, because the loading capacity is equated to the Numeric Target, the hydrodynamic processes are not quantified. In-stream processes, such as binding to organic material, are thought to only decrease the dissolved metals' concentration in Chollas Creek and are, thus, considered an implicit MOS. Table 6.1 presents the loading capacities for the dissolved metals copper, lead and zinc.

TABLE 6.1. Dissolved metals loading capacities for acute and chronic conditions.

Metal	Loading Capacity for Acute Conditions – One-Hour Average	Loading Capacity for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

The natural log and exponential functions are represented as "ln" and "e", respectively.

These loading capacities, which are equal to the Numeric Targets, will apply to the entirety of Chollas Creek and during all times of the year. Each of the land uses identified in the Source Analysis portion of this TMDL will not be allowed to have runoff that causes in-stream waters to exceed these concentrations. Further more, all other sources of copper, lead and zinc to Chollas Creek will be expected to not cause the creek to exceed these loading capacities. Once these capacities are achieved, it is expected that Chollas Creek copper, lead and zinc concentrations will be protective of the creek's beneficial uses.

A concentration-based approach was chosen to link the Numeric Targets with the largest identified metal source -- urban runoff. This approach is considered more appropriate than a mass-based approach, because not only does it take into account the dynamic nature of urban runoff, which is greatly affected by stormwater, but it also accommodates the dynamic nature of freshwater systems that have a myriad of flow and hardness conditions. Metals concentrations are also generally easier to monitor; however, hardness measurements will also be needed and sampling will need to be in accordance with Table 4.2.

In addition, a mass-based approach would be more sensitive to concerns of accumulated bottom sediment in fresh water bodies and down stream sediment toxicity. However, as discussed in the Source Analysis section, sediment is not considered a source of metals due to the nature of Chollas Creek and due to low sediment toxicity results. In addition, downstream sediment toxicity is to be addressed in a separate TMDL once adequate data are collected and applicable models are developed for the Chollas Creek Watershed.

7. MARGIN OF SAFETY

The TMDL must contain a MOS to account for uncertainty in the analysis. The MOS for Chollas Creek is explicit as well as implicit. The explicit MOS was calculated by taking 10 percent of the total loading capacity as generated from the CTR equation, using the currently sampled hardness concentration. This 10 percent amount is essentially reserved: It is not available for waste load allocation or load allocation and therefore makes these allocations smaller and thus, more protective. For example, if the CTR equation, using the currently sampled hardness concentration, calculated a loading capacity of 106 kg Cu/L, then 10 percent or 11 (kg Cu/L) would be allocated to the MOS. Therefore, the waste load allocation and load allocation together would have to be equal to 95 kg Cu/L/year (106 kg Cu/L minus 11 kg Cu/L). This reservation is to account for (1) uncertainty associated with the calculations in the source analysis and linkage analysis, (2) any difference between total metal concentrations and dissolved,[23] or assumed bioavailable, metal concentrations and (3) the uncertain effects that default, or non site-specific, CTR values had on the TMDL loading capacity.[24]

Using actual hardness values in the CTR equation in order to calculate TMDLs is an implicit MOS. The other alternative was to use an estimated hardness value from a model, a flow-correlation, or an average from past data. Because past data were very limited, an estimated hardness would in itself have a great amount of uncertainty and this uncertainty would be incorporated into the TMDL concentration if an estimated hardness would be used in the CTR equation. Also, although not an MOS by definition, the derivation of the CTR's criteria maximum concentration (CMC) takes safety into account, because it divides the Final Acute Value, determined from laboratory acute toxicity concentrations, by a safety factor of two (Stephan, 1985). In summary, staying as close as possible to the CTR definition gives assurance that the TMDL is a conservative, defendable value.

Another implicit MOS is not allowing for metal interactions with anions and negatively charged sites on particulates when calculating the loading capacity and allocations. Theoretically, an increase in bioavailability from these types of chemical interactions in water would only take place in waters with low pH levels. The increased aqueous acidity (low pH levels) would yield higher levels of free metal ions and thereby increase bioavailability to aquatic organisms. Such low pH levels in ambient waters are more likely to be observed in areas of high acid rain; these low pH conditions are not likely in San Diego. Therefore, metal interactions with negatively charged anions and particles within the water are assumed to only decrease bioavailability. Not allowing for this interaction makes the TMDL concentration more conservative.

8. TMDL AND ALLOCATIONS

The TMDL must be less than or equal to the loading capacity after taking into account allocations to all sources. The TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a MOS that may either explicitly reserve an allocation for or implicitly account for the uncertainty in the

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[23] Although dissolved concentration is the most appropriate value to use for metals [40 CFR 131], any additional concern is addressed by the 10% MOS.

[24] The 10% MOS helps account for any additional uncertainties in calculating the Load and Waste Load Calculations due to use of the CTR default conversion factors and water effect ratio. Although CTR's guidance was strictly followed (when there is not enough site-specific data default values are used) there may remain a chance that if the data were available, these site-specific values would result in a more stringent TMDL concentration than the default values. Additional studies may also be preformed in the future to create site-specific values (Appendix H).

relationship between pollutant loads and the quality of the receiving waterbody. In this TMDL, 10 percent of the load is reserved for an MOS, or not allocated to sources, in order to account for identified uncertainties in the TMDL in addition to conservative assumptions made in the TMDL analysis (Margin of Safety Section). Conceptually, Equation 8.1 represents this definition.

EQUATION 8.1. Fundamental Total Maximum Daily Load (TMDL)

$$\mathbf{TMDL = \sum WLAs + \sum LAs + MOS}$$

In TMDL development, allowable WLA and LA from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. TMDLs can be expressed on a mass loading basis (e.g., grams of pollutant per year) or as a concentration in accordance with provisions in federal regulations [40 CFR 130.2(l)]. In addition, TMDLs and associated WLA and LA must be expressed in quantitative terms [40 CFR 130.2 (e-i) and 40 CFR 130.7 (c)]. For Chollas Creek, the WLAs and LAs and consequently the TMDL, are expressed as a concentration. This decision was made based on the concentration-based approach and quantitative linkage analysis. (See section 6.0, Linkage Analysis) In addition, the concentration-based TMDL will account for any future point or nonpoint sources, because any future sources will also be required to be below the same concentration.

Concentration-based allocations are not additive; therefore, the allocations for point, nonpoint and background sources (WLAs and LAs) will all be the same concentration. Further, the LAs and WLAs for Chollas Creek are set equal to the loading capacities for both acute and chronic conditions as determined by the sampling requirements in Tables 4.2 & 8.1). In addition, an explicit MOS reserves 10 percent of the total allocation and subsequently reduces the TMDL (and therefore the WLA and LA) concentration by the same amount (Equation 8.2 and Table 8.2). If all copper, lead and zinc contributing sources to Chollas Creek meet their respective TMDL concentration, the loading capacity in the creek should not be exceeded.

TABLE 8.1. Dissolved metals loading capacities for acute and chronic conditions, as determined by sampling requirements in TABLE 4.2.

Metal	Loading Capacity for Acute Conditions – One-Hour Average	Loading Capacity for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]}	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]}
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]}	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]}

EQUATION 8.2. Margin of Safety (MOS) in the form of the general California Toxic Rule (CTR) equation for dissolved metals criteria.
MOS = - (exp {m * [ln (hardness)] + b} * CF) *.1

TABLE 8.2. The Total Maximum Daily Load (TMDL) for dissolved copper, lead and zinc for acute and chronic conditions

Metal	TMDL for Acute Conditions – One-Hour Average	TMDL for Chronic Conditions – Four-Day Average
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

8.1. Wasteload Allocations

Federal regulations [40 CFR 130.7] require TMDLs to include individual WLAs for each point source discharge. The point sources that could affect Chollas Creek are the MS4 discharges, stormwater discharges from industrial sites, and discharges of extracted groundwater. Order No. 2001-01 for San Diego County covers the entire Chollas Creek Watershed, including the creek itself and regulates all wet and dry weather runoff that enters the creek through the stormwater conveyance system (SDRWQCB, 2001). All other existing WDR orders applicable to regulating metal sources regulate discharges that reach Chollas Creek directly through the MS4 system. For example, the stormwater WDR order for CalTrans (Order No. 99-06-DWQ) regulates freeway runoff that flows into the MS4 system. A full list of the existing WDR orders applicable to this TMDL is discussed in the Source Analysis section (section 5.0). All point source discharges to Chollas Creek are expected to achieve this WLA.

Modeling results, also discussed in the Source Analysis section, demonstrate the possible land use specific and sub-watershed specific contributions of copper, lead and zinc. However because this WLA is concentration-based it will apply to each land use and each sub-watershed at all times and will not be specific to any land use or sub-watershed. Therefore, the model predictions of the relative metal contribution from each category will be useful in targeting problem areas during implementation.

8.2. Load Allocations

The LAs are assigned to nonpoint sources and natural background sources in the watershed. Background sources can include air deposition of metals in the watershed and any groundwater contributions. Because of the regulatory definition of the MS4 system, all source (point and nonpoint sources) contributions of metals to Chollas Creek come via the MS4 and are therefore accoutend for in the allocation assigned to the MS4s. The only other possible sources that may end up directly in Chollas Creek would be direct air deposition and groundwater, which may or may not include anthropogenic sources. As discussed in the Source Analysis section, these two sources are not considered significant at this time. These sources may be re-evaluated at a future date if any additional data become available. Currently, the sources contributing to the LAs not accounted for in the WLA assigned to the MS4s are considered to be relatively insignificant. Thus, in the TMDL calculation, the LAs are equal to zero, and the TMDL calculations are equal to the WLAs

9. SEASONAL VARIATIONS AND CRITICAL CONDITIONS

In accordance with federal regulations [40 CFR 130.7(c)], a TMDL must consider seasonal variations and critical conditions (e.g. stream flows, pollutant loadings and other water quality parameters). A flow-based approach was used for the Chollas Creek Metals TMDL, and defines critical conditions solely based on freshwater flow rates regardless of season. No matter the time of year or situation, toxicity allocations that are based on the CTR equations will be required throughout all segments of Chollas Creek and therefore, by definition, will always be protective of aquatic life.

Furthermore, the flow-based approach is appropriate because the main sources of metal accumulation in the Chollas Creek Watershed are non-seasonal (e.g. automobile wear, exhaust emissions, industry contributions). Urban runoff, which is the main mechanism by which these accumulated metals reach Chollas Creek, can occur in both dry and wet weather. As explained previously, urban runoff is a combination of base-flows (e.g. car washing, lawn watering) during dry weather and stormwater flows during wet weather. Because the climate in southern California can be described as dry weather most of the year and intermittent wet weather events throughout the year, wet weather and dry weather are also most easily characterized by precipitation flow rates as opposed to being characterized by season. To further address these differences, both the CMC and CCC equations are used for determining a metal's allocation in order to be protective for both acute and chronic conditions.

The allowable concentration will be determined with hardness values measured at the time of compliance. These data will provide a direct measure of any seasonal variations and/or critical conditions effects on hardness. Since hardness is an essential component of the LA and WLAs, seasonal variations and/or critical conditions will be covered by this TMDL. This method of using sampled hardness as the variable instead of an estimated hardness, will account for these effects because it is an absolute representation of current conditions and thus will account for any effects that may be caused by seasonal variations or extreme conditions. Other stream chemistry, which may or may not be a function of seasonal variations and critical conditions, were not taken into consideration as an implicit MOS and will therefore not have a bearing, with respect to seasonal variations and critical conditions, on the TMDL.

IMPLEMENTATION PLAN AND ENVIROMENTAL REVIEW

10. LEGAL AUTHORITY

This section presents the legal authority and regulatory framework used as a basis for assigning responsibilities to dischargers to implement and monitor compliance with the Chollas Creek Metals TMDL project. The laws and policies governing point source[25] discharges are described below. Non-point source discharges are not discussed because these discharges are negligible in the Chollas Creek watershed, and did not receive load allocations or reductions. Discharger accountability for attaining metals wasteload allocations is established. The legal authority and regulatory framework is described in terms of the following:

- Controllable water quality factors;
- Regulatory background; and
- Persons accountable for point source discharges

10.1. Controllable Water Quality Factors

The Chollas Creek watershed lies within the Pueblo 908.00 Hydrologic Unit. The vast majority of metal are transported from sources to Chollas Creek from wet and dry weather runoff generated from human habitation and land use practices, and to a lesser extent, direct atmospheric deposition. Construction, maintenance, and operation of State-owned highways are also sources of metal discharges to Chollas Creek. These metal discharges result from controllable water quality factors which are defined as those actions, conditions, or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled. This TMDL project establishes wasteload allocations for these controllable discharges.

10.2. Regulatory Background

CWA section 402 establishes the NPDES Program to regulate the ‘‘discharge of a pollutant,’’ other than dredged or fill materials, from a ‘‘point source’’ into ‘‘waters of the U.S.”[26] Under section402, discharges of pollutants to waters of the U.S. are authorized by obtaining and complying with WDRs that implement the NPDES regulations. These WDRs commonly contain numerical discharge limits for specified

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[25] The term ‘‘point source’’ is defined in Clean Water Act section 502(6) to mean any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

[26] See federal regulations [40 CFR section 122.2(c)(e)]. The USEPA has interpreted “waters of the United States” to include “intrastate lakes, rivers, streams (including intermittent streams) . . . the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce,” and “tributaries of [those] waters.” Chollas Creek is a water of the United States.

pollutants and required best management practices[27] (BMPs) designed to minimize water quality impacts. Numerical effluent limitations and BMPs (or other non-numerical effluent limitations) implement both technology-based and water quality based requirements of the CWA. Technology-based limitations represent the degree of control that can be achieved by point sources using various levels of pollution control technology. If necessary to achieve compliance with applicable WQSs, WDRs implementing NPDES regulations must contain water quality-based limitations more stringent than the applicable technology-based standards.

Within each TMDL, a "wasteload allocation"[28] is determined which is the maximum amount of a pollutant that may be contributed to a waterbody by "point source" discharges of the pollutant in order to attain and maintain WQOs. WDRs implementing NPDES regulations must include water quality-based effluent limits or conditions that are consistent with the assumptions and requirements of the wasteload allocation. The principle regulatory means of implementing TMDLs for point source discharges regulated under these types of WDRs are:

1. Allocate the total wasteload allocation calculated for point source facilities among each individual NPDES point source facility that is discharging the pollutant that needs to be controlled;

2. Evaluate whether the effluent limitations or conditions within the WDRs implementing NPDES regulations are consistent with the wasteload allocations. If not, incorporate effluent limitations that are consistent with the wasteload allocations into the WDRs[29] or otherwise revise the WDRs to make them consistent with the assumptions and requirements of the TMDL wasteload allocations.[30] A time schedule

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[27] See federal regulations [40 CFR section 122.2] BMPs means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. The term BMP is extensively used in the point source program in connection with WDRs implementing NPDES regulations where implementation of BMPs is enforceable.

[28] See federal regulations [40 CFR section 130.2(h)]. A wasteload allocation is the portion of the receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution.

[29] In the case of WDRs implementing NPDES regulations, effluent limitations may include best management practices that evidence shows are consistent with the wasteload allocation.

[30] See federal regulations [40 CFR section 122.44(d)(1)(vii)(B)]. NPDES water quality-based limits must be consistent with the assumptions and requirements of any available TMDL wasteload allocation. The regulations do not require the effluent limits to be identical to the wasteload allocation. The regulations leave open the possibility that the Regional Board could determine that fact-specific circumstances render something other than literal incorporation of the wasteload allocation to be consistent with the TMDL assumptions and requirements. The rationale for such a finding could include a trade amongst dischargers of portions of their load or wasteload allocations, performance of an offset program that is approved by the Regional Board, or any number of other considerations bearing on facts applicable to the circumstances of the specific discharger.

to achieve compliance should also be incorporated into the WDRs in instances where the discharger is unable to immediately comply with the required wasteload reductions;

3. Mandate discharger compliance with the wasteload allocations in accordance with the terms and conditions of the revised WDRs;

4. Implement a monitoring and/or modeling plan designed to measure the effectiveness of the controls implementing the wasteload allocations and the progress the waterbody is making toward attaining WQOs; and

5. Establish criteria to determine that substantial progress toward attaining water quality standards is being made and if not, the criteria for determining whether the TMDLs or wasteload allocations needs to be revised.

10.3. Persons Responsible for Point Source Discharges

For Chollas Creek, all metal loading essentially comes to the creek through the MS4s within the watershed. MS4 discharges are point source discharges because they are released from channelized, discrete conveyance pipe systems and outfalls. Background loads and loads from air depositions are negligible compared to the loads delivered from the MS4s as discussed in section 5. Discharges from MS4s to navigable waters of the U.S. are considered to be point source discharges and are regulated in California through the issuance of WDRs that implement NPDES regulations. Persons owning and/or operating MS4s tributary to Chollas Creek include CalTrans, the cities of San Diego, Lemon Grove, and La Mesa, San Diego County, and the Navy.

The following discussion describes the persons responsible for actual or potential MS4 point source discharges of metals to the Chollas Creek watershed. These dischargers have specific roles and responsibilities assigned to them for achieving compliance with the metals wasteload allocations described in section 11.0, Implementation Action Plan.

10.4. California Department of Transportation

CalTrans is responsible for the design, construction, maintenance, and operation of the California State Highway System, including the portion of the Interstate Highway System within the State's boundaries. The roads and highways operated by Caltrans are legally defined as MS4s and discharges of pollutants from Caltrans MS4s to waters of the U.S., such as Chollas Creek, constitute a point source discharge that is subject to regulation under WDRs implementing federal NPDES regulations.

Discharges of storm water from the Caltrans owned right-of-ways, properties, facilities, and activities, including storm water management activities in construction, maintenance, and operation of State-owned highways are regulated under Order No. 99-06-DWQ.[31]

[31] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit Statewide Storm Water Permit and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans).*

CalTrans is responsible, under the terms and conditions of these WDRs, for ensuring that their operations do not contribute to violations of water quality objectives in Chollas Creek.

CalTrans is a point source discharger of metals to Chollas Creek. CalTrans discharges storm water runoff containing metals from Interstates-5, 15 and 805 freeway surfaces, and State Highway 94 freeway surfaces and adjacent land areas via a storm drain system. Stormwater runoff from highways can contain pollutants, including metals, from vehicle exhaust and atmospheric deposition. These discharges are contributing to the exceedances of the metals water quality objectives in Chollas Creek.

10.5. Cities of San Diego, Lemon Grove, and La Mesa, San Diego County, and the San Diego Unified Port District

The Municipal Dischargers discharge urban runoff to Chollas Creek via MS4s that are regulated under WDRs prescribed in Order No. 2001-01.[32] Under the terms and conditions of Order No. 2001-01, the Municipal Dischargers are responsible for controlling all storm and non-storm water flows (i.e., urban runoff) that are transported through their respective MS4s to surface waters.

The Municipal Dischargers are point source dischargers of metals to Chollas Creek. Metals are present in stormwater and urban runoff from commercial/industrial and transportation land use activities within these jurisdictions. Metal-laden stormwater and urban runoff are discharged to Chollas Creek via the MS4s. These discharges are contributing to the exceedances of the metals water quality objectives in Chollas Creek.

10.6. U.S. Navy

There is a small portion of the Chollas Creek watershed, immediately adjacent to San Diego Bay, which is under the jurisdiction of the Navy. Navy Station San Diego west of Harbor Drive[33] appears to drain directly to San Diego Bay, and if so, does not contribute metals to Chollas Creek. However, east of Harbor Drive, facility MS4s discharge into Chollas Creek.

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[32] Order No. 2001-01, *Waste Discharge Requirements for Discharges of Urban Runoff from the Municipal Separate Storm Sewer Systems Draining the Watersheds of the County of San Diego, the Incorporated Cities of San Diego County, and the San Diego Unified Port District*, NPDES No. CAS0108758

[33] These lands are regulated under Order No. R9-2003-0265, NPDES Permit No. CA0107867, *Waste Discharge Requirements for U.S. Navy Graving Dock Located at Naval Station San Diego* and Order No. R9-2002-0169, NPDES Permit No. CA0109169, *Waste Discharge Requirements for U.S. Navy Base San Diego*.

A statewide order prescribing general WDRs for discharges from small MS4s[34] regulates urban runoff not covered by the Regional Board's phase I MS4 WDRs (Order No. 2001-01), including discharges from MS4s on military bases. The Navy's discharge from its MS4 into Chollas Creek can be regulated by enrolling this facility under the statewide order.

10.7. Persons Discharging Stormwater Regulated Under Statewide General NPDES WDRs

Industrial facilities, construction sites, and utility vaults generate stormwater that can be discharged to Chollas Creek via the MS4s. Stormwater discharges from industrial facilities, construction sites, and utility vaults in the Chollas Creek watershed are regulated under statewide general NPDES WDRs prescribed in Order No. 99-08-DWQ, Order No. 99-08-DWQ, and Order No. 2001-11-DWQ, respectively.[35]

Stormwater discharges from industrial sites in Chollas Creek watershed may contain dissolved metals concentrations that contribute to exceedances of metals water quality objectives in Chollas Creek. Therefore, Chollas Creek enrollees under the Industrial Stormwater WDRs are responsible for potential MS4 point source discharges of metals to the Chollas Creek.

The principal pollutants of concern for construction site discharges are sediment and total suspended solids. BMPs to control sediment discharges should also control metals discharges since metals from construction sites are likely to be adsorbed to soils. Similarly, for utility vault discharges, the principal pollutants of concern are total suspended solids, oil and grease. In addition, utility vaults are typically located beneath sidewalks rather than roads. Storm water leaking into a utility vault from a sidewalk is not likely to contain significant metals concentrations because of the lack of contact between sidewalks and cars. Because construction site discharges and utility vault discharges are unlikely to contain significant metals concentrations, persons discharging stormwater to MS4s from construction sites and utility vaults will not be assigned a wasteload allocation for metals discaharges in this TMDL project.

10.8. Persons Discharging Groundwater Regulated Under Regional Board General NPDES WDRs.

Groundwater discharges from dewatering sites can be discharged to Chollas Creek via the MS4s. These discharges are regulated under Regional Board general NPDES WDRs

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[34] SWRCB Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004, *Waste Discharge Requirements for Storm Water Discharges from Small Municipal Separate Storm Sewer Systems*.

[35] Order No. 97-03-DWQ NPDES No. CAS 000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industiral Activities Excluding Construction Activities*. Active enrollees in the Chollas Creek watershed include A to Z Auto Dismantling, IMS Recycling Services, Mini Trucks and Cars, Trolley Auto Parts, Able Auto Wrecking, Pacific Coast Recycling- Always Recycling.
Order No. 99-08-DWQ NPDES No. CAS 000002 General Construction Storm Water WDRs.
Order No. 2001-11-DWQ NPDES No. CAG 99002 General Utility Vault WDRs.

prescribed in Order No. 2001-96.[36] Groundwater discharges may contain naturally occurring dissolved metals concentrations, or enriched concentrations from overlying metals contaminated soils that contribute to exceedances of metals water quality objectives in Chollas Creek. Order No. 2001-96 contains numerical effluent limitations for copper, lead and zinc that are equivalent to the CTR WQOs. At this time, there are no enrollees discharging extracted groundwater to MS4s in the Chollas Creek watershed. However, copper, lead, and zinc wasteload reductions for groundwater dewatering will be required in the event that future groundwater dewatering dischargers apply for coverage under Order No. 2001-96 to ensure that water quality standards are attained and maintained in Chollas Creek.

[36] Order No. 2001-90, NPDES No. CAG19001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or other Conveyance Systems Tributary Thereto.*

11. IMPLEMENTATION ACTION PLAN

This Chapter describes the actions necessary to implement the TMDL to attain and maintain copper, lead and zinc WQOs in Chollas Creek. The plan describes implementation responsibilities assigned to cooperating agencies and dischargers and describes the schedule and key milestones for the actions to be taken. A monitoring strategy to assess the success of this implementation action plan is presented in section 12, Implementation Monitoring Plan.

The goal of the Implementation Action Plan is to ensure that Chollas Creek does not exceed CTR WQOs[37] for copper, lead and zinc at all times and in all points of the creek. Since nonpoint source discharges to the creek are considered negligible, compliance with the TMDL will be accomplished by ensuring that all point source discharges meet the WLAs as set forth in section 8 of this Technical Report. Applicable WDRs will be revised to incorporate WLAs to ensure that the discharges comply with the WLAs and do not contribute to an exceedance of the WQOs in Chollas Creek

11.1. Regulatory Authority for Implementation Plans

TMDL implementation plans are not currently directly required under federal law; however it is federal policy that TMDLs should include implementation plans. CWA section 303 [40 CFR 130] authorizes USEPA to require implementation plans for TMDLs. Although current USEPA regulations implementing section 303 do not now require states to include implementation plans for TMDLs, they are likely to be revised in the future to do so. USEPA regulations [40 CFR 130.6] do require states to incorporate TMDLs in the State Water Quality Management Plans (Basin Plans) along with adequate implementation measures to implement all aspects of the plan (including the TMDLs). USEPA policy is that states must include implementation plans as an element of TMDL Basin Plan amendments submitted to EPA for approval.[38]

TMDL implementation plans are required under State law. Basin plans must have a program of implementation to achieve WQOs.[39] The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with the WQOs.[40] State law requires that a TMDL include an implementation action plan because the TMDL normally is, in essence, an interpretation or refinement of an existing water quality objective. The TMDLs and WLAs must be incorporated into the Basin

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37 [40 CFR 131.38(b)(2)]

38 See *Guidance for Developing TMDLs in California,* USEPA Region 9, (January 7, 2000), Page 11

39 See CWC section 13050(j). A "Water quality control plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) Water quality objectives and (3) A program of implementation needed for achieving water quality objectives.

40 See CWC section 13242.

Plan.[41] Because the TMDL supplements, interprets, or refines existing WQOs, State law requires a program of implementation.

11.2. Implementation Action Plan Objectives

The specific objectives of this Implementation Action Plan are as follows:

1. Amend the different statewide and Regional Board orders that regulate point source discharges to Chollas Creek to require that urban runoff discharges from MS4s achieve the WLAs set forth in section 11.3 below, prior to discharge to Chollas Creek;

2. Establish mechanisms to track BMP implementation, monitor BMP effectiveness in achieving the WLAs in urban runoff discharges to and from MS4s, assess success in achieving TMDL objectives and milestones, and report on TMDL program effectiveness in attaining the copper, lead and zinc water quality objectives in Chollas Creek.

3. Establish a time schedule for meeting the WLAs of this TMDL project. The schedule will establish annual milestone that are to be achieved until the WLAs are achieved.

4. Identify the regulatory authority under which the Regional Board will direct the NPDES dischargers to initiate the elements of the implementation plan. This will only be required if the relevant WDRs are not modified to incorporate wasteload allocations in a timely manner.

5. Identify the persons responsible for meeting the WLAs in urban runoff discharged to Chollas Creek.

11.3. Waste Load Allocations and Responsible Persons

The WLAs must be met in urban runoff discharged to Chollas Creek. The Chollas Creek metals WLAs are expressed as concentrations equal to 90 percent of the loading capacities for the three metals. The loading capacities are equal to the hardness based CTR maximum (acute) and continuous (chronic) criteria for copper, lead, and zinc. Setting the WLAs equal to ninety percent of the loading capacity provides the explicit MOS. Because the toxicity of dissolved metals varies with hardness, the CTR criteria are expressed as the equations in Table 4.1 below. Background sources and nonpoint sources of metals were insignificant. Therefore, this TMDL has no LAs.

Persons whose discharges contribute to the exceedance of WQOs for copper, lead and zinc in Chollas Creek (as discussed in section 10) will be required to meet the WLA hardness dependant concentrations in their urban runoff discharges before it is discharged to Chollas Creek. The Municipal Dischargers and CalTrans are responsible for meeting the WLAs in their urban runoff prior to discharge to Chollas Creek because they own or

[41] See Clean Water Act section 303(e).

TABLE 11.1 The Wasteload Allocations for dissolved copper, lead and zinc for acute and chronic conditions

Metal	WLA for Acute Conditions – One-Hour Average = Loading Capacity* MOS	WLA for Chronic Conditions – Four-Day Average =Loading Capacity*MOS
Copper	(0.96) * {e^ [0.9422 * ln (hardness) - 1.700]}*0.9	(0.96) * {e^[0.8545 * ln (hardness) - 1.702]}*0.9
Lead	[1.46203 – 0.145712 * ln (hardness)] * {e^ [1.273 * ln (hardness) - 1.460]} * 0.9	[1.46203 – 0.145712 * ln (hardness)] * {e^[{1.273 * ln (hardness)} - 4.705]} * 0.9
Zinc	(0.978) * {e^ [0.8473 * ln (hardness) + 0.884]} * 0.9	(0.986) * {e^[0.8473 * ln (hardness) + 0.884]} * 0.9

operate MS4s that discharge copper, lead, and zinc to Chollas Creek. The US Navy facility, Naval Station San Diego, has MS4s that drain directly to Chollas Creek. The Navy is responsible for meeting the WLAs in its MS4 urban runoff discharges to Chollas Creek.

Persons enrolled in the statewide General Industrial WDRs (SWRCB Order No. 99-08-DWQ) will be also be required to meet the WLAs in their regulated discharges to Chollas Creek. At this time, there are no persons enrolled in the general WDRs for Groundwater Extraction Discharges to San Diego Bay and Tributaries (Regional Board Order No. 2001-90).

11.4. Compliance Schedule and Interim Goals for Achieving Wasteload Allocations

The purpose of these TMDLs is to attain and maintain the applicable WQOs in Chollas Creek through incremental mandated wasteload reductions of pollutants in point sources discharging to the creek. The TMDL requires dischargers to improve water quality conditions in the Chollas Creek receiving water by achieving wasteload reductions in their discharges. The copper, lead and zinc TMDLs shall be implemented in an incremental approach with a monitoring component to determine the effectiveness of each phase and guide the selection of BMPs.

Concentrations of metals in urban runoff shall only be allowed to exceed the WLAs by a certain percentage for the first five years after adoption of this TMDL. Allowable concentrations shall decrease by 20 percent each year during this time (Table 11.2). For example, if the measured hardness four years after OAL approval of this TMDL project dictates the WLA for copper in urban runoff is 10 µg/l, the maximum allowable measured copper concentration would be 14 µg/L. The phases require loading reductions in incremental steps through the use of expanded or better tailored BMPs to achieve the ultimate goal of attaining and maintaining compliance with copper, lead, and zinc water quality objectives. By the end of the seventh year after OAL approval of this TMDL, the WLAs of this TMDL shall be met. This will ensure that copper, lead and zinc water quality objectives are being met at all locations in the creek during all times of the year.

TABLE 11.2 Compliance schedule and interim goals for achieving Wasteload Allocations

	Allowable Exceedance of the WLAs (allowable percentage above)		
Compliance Year (year after OAL approval)	**Copper**	**Lead**	**Zinc**
1	100%	100%	100%
2	100%	100%	100%
3	100%	100%	100%
4	50%	50%	50%
5	25%	25%	25%
6	10%	10%	10%
7	0%	0%	0%

Compliance with the interim goals in this schedule can be assessed by showing that dissolved metals concentrations in the receiving water exceed the WQOs for copper, lead, and zinc by no more than the allowable exceedances for WLAs shown in Table 11.2. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges.

Dischargers are expected to implement metal reduction BMPs during the first year after OAL approval of this TMDL, with all necessary metal load reductions being achieved within seven years.[42] The first three years of the compliance schedule do not represent a significant decrease from current conditions. These years will provide the dischargers time to develop plans and implement enhanced and expanded BMPs that should result in immediate decreases of metal concentrations in the Chollas Creek water column. Three years are provided for these measures to begin to lower Chollas Creek metal concentrations before the first reduction is required.

11.5. Regional Board Actions

This section describes the actions that the Regional Board will take to implement the TMDL.

1. **CalTrans – Amend Order No. 99-06-DWQ, Statewide WDRs for CalTrans MS4 Discharges**
   The Regional Board shall request the SWRCB amend Order No. 99-06, the statewide CalTrans NPDES MS4 order[43] to include the following:

[42] This TMDL will be implemented through existing orders prescribing WDRs that implement NPDES regulations. The SWRCB *Policy for Implementation of Toxics Standards for Inland Surface Waters, (Enclosed Bays, and Estuaries of California, Phase 1 of the Inland Surface Waters Plan and the Enclosed Bay and Estuaries Plan* provides that the schedule of compliance for point source discharges in an NPDES Permit shall not exceed 5 years from the date of permit issuance, reissuance or medication.

[43] Order No. 99-06-DWQ, NPDES No. CAS000003, *National Pollutant Discharge Elimination System (NPDES) Permit, Statewide Storm Water Permit, and Waste Discharge Requirements (WDRs) for the State of California, Department of Transportation (Caltrans)*, or subsequent superceding NPDES renewal

a. The WLAs and schedule of compliance applicable to MS4 discharges into Chollas Creek described in Table 11.2.

b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

c. A requirement to submit annual progress reports to the Regional Board on the progress in attaining the WLAs in urban runoff discharges and WQOs in Chollas Creek. The reports shall be due on April 1 of each year and shall be incorporated within the report required by section 2, Program Management of Order No. 99-06. Reporting shall continue on an annual basis until the metals WQOs are attained and maintained in Chollas Creek.

The reports should describe the BMPs being implemented by CalTrans in the Chollas Creek watershed and additional BMPs that will be implemented. The reports should describe the steps CalTrans will take to develop a long-term strategy for assessing the effectiveness of its BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that it will use to track the long-term progress towards achieving the copper, lead and zinc load reductions required under this TMDL. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

2. **Municipal Dischargers - Amend Regional Board Order No. 2001-01, WDRs for San Diego County MS4 Discharges**
The Regional Board shall amend Order No. 2001-01 to include:

a. The WLAs and schedule of compliance applicable to MS4 discharges into Chollas Creek described in Table 11.2.

b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

c. A requirement that the Municipal Dischargers submit annual progress reports to the Regional Board on the progress in attaining the WLAs in effluent discharges and WQOs in Chollas Creek. Annual reports shall cover the period of July 1 through June 30. The reports shall be submitted to the Regional Board by January 31 of the following year and shall be incorporated within the annual receiving water monitoring reports required in Table 6, Item 28, page 51 of Order No. 2001-01. Reporting shall continue on an annual

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Orders.

basis until the metal water quality objectives are attained and maintained in Chollas Creek.

The reports should describe the BMPs being implemented by the Municipal Dischargers in the Chollas Creek watershed and additional BMPs that will be implemented. The reports should describe the steps the Municipal Dischargers will take to develop a long-term strategy for assessing the effectiveness of their BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that they will use to track the long-term progress towards achieving the copper, lead and zinc WLAs required under this TMDL Project. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

For copper, lead and zinc discharges in urban runoff to or from MS4s within the Chollas Creek watershed, the Municipal Dischargers have an existing obligation under Order 2001-01 to require increasingly stringent BMPs, pursuant to the iterative process described in Receiving Water Limitation C.2.a.[44] of the Order, to reduce metal discharges in the Chollas Creek watershed to the maximum extent practicable and to restore compliance with the copper, lead and zinc components of the toxic pollutants water quality objectives.

3. **Municipal Dischargers and the Navy – Amend Order No. R9-2004-0277, Chollas Creek Investigation and Monitoring Program for Diazinon and Metals**
The Regional Board shall amend Order No. R9-2004-0277) to include the following: A requirement that the Municipal Dischargers and CalTrans investigate excessive levels of metals in Chollas Creek and feasible management strategies to reduce metal loadings in Chollas Creek. The amendment will require additional monitoring to collect the data necessary to refine the watershed wash-off model to provide a more accurate estimate of the mass loads of copper, lead and zinc leaving Chollas Creek each year.

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[44] Receiving Water Limitation C.2.a provides that "[u]pon a determination by either the Copermittee or the Regional Board that MS4 discharges are causing or contributing to an exceedance of an applicable water quality standard, the Copermittee shall promptly notify and thereafter submit a report to the Regional Board that describes BMPs that are currently being implemented and additional BMPs that will be implemented to prevent or reduce any pollutants that are causing or contributing to the exceedance of water quality standards…"

4. **Amend Order No. R9-2000-90, General WDRs for Groundwater Extraction Discharges**
   The Regional Board will amend Order No. R9-2000-90,[45] which regulates temporary groundwater extraction discharges to San Diego Bay and its tributaries. The effluent limitations for copper, lead, and zinc will be revised to equal the WLAs for extracted groundwater discharges to MS4s in the Chollas Creek watershed, and directly to Chollas Creek. Regulated groundwater discharges to Chollas Creek must meet the WLAs at the initiation of the discharge. No schedule to meet interim goals will be allowed in the case of groundwater discharges. A revision of the receiving water limitations is not required since they are equal to the WQOs for metals in Chollas Creek.

5. **Amend Order No. 97-03-DWQ, Statewide General WDRs for Industrial Facilities Stormwater Discharges**
   The Regional Board shall request the SWRCB amend Order No. 97-03-DWQ, the statewide general WDRs that regulate stormwater discharges from industrial sites[46] to include the following:

   a. The WLAs and schedule of compliance applicable to industrial facility stormwater discharges into Chollas Creek described in Table 11.2.

   b. A requirement to implement an iterative BMP approach of expanded or better-tailored BMPs to attain the WLAs in Table 11.1 in accordance with the compliance schedule in Table 11.2 of this Technical Report.

   c. A requirement to submit annual progress reports to the Regional Board on the progress in attaining the WLAs in effluent discharges. The reports shall be due on July 1 of each year and shall be incorporated within the annual report required by section A.14 of Order No. 97-03-DWQ. Reporting shall continue on an annual basis until the metals WQOs are attained and maintained in Chollas Creek.

      The report should describe the steps industrial dischargers will take to develop a long-term strategy for assessing the effectiveness of its BMPs. The long-term assessment strategy should identify specific direct and indirect measurements that it will use to track the long-term progress towards achieving the copper, lead and zinc load reductions required by this TMDL. Methods used for assessing effectiveness should include the following or their equivalent: surveys, pollutant loading estimations, and receiving water quality

[45] Order No. R9-2000-90, NPDES Permit No. CAG919001, *General Waste Discharge Requirements for Temporary Groundwater Extraction and Similar Waste Discharges to San Diego Bay and Storm Drains or Other Conveyance Systems Tributary Thereto* or subsequent superceding NPDES renewal orders.

[46] Order No. 97-03-DWQ, NPDES Permit No. CAS000001, *Waste Discharge Requirements for Discharges of Storm Water Associated with Industrial Activities Excluding Construction Activities* or subsequent superceding NPDES renewal orders.

monitoring. The long-term strategy should also discuss the role of monitoring data in substantiating or refining the assessment.

6. **Take Enforcement Actions**
   The Regional Board shall consider enforcement action,[47] as necessary, against any discharger failing to comply with applicable waiver conditions, WDRs, discharge prohibitions, or take enforcement action, as necessary, to control the discharge of metals to Chollas Creek, to attain compliance with the metals WLAs specified in this Technical Report, or to attain compliance with the metals WQOs. The Regional Board may also terminate the applicability of waivers and issue WDRs or take other appropriate action against any discharger(s) failing to comply with the waiver conditions.

7. **Recommend High Priority for Grant Funds**
   The Regional Board shall recommend that the SWRCB assign a high priority to awarding grant funding[48] for projects to implement the Chollas Creek metal TMDLs. Special emphasis will be given to projects that can achieve quantifiable metal load reductions consistent with the specific metal TMDL WLAs.

8. **Enroll the Navy in Order No. 2003-0005-DWQ, Statewide general WDRs for Discharges from Small MS4s**
   Upon receipt of a complete Report of Waste Discharge (ROWD), the Regional Board shall enroll the Navy community facilities of Naval Base San Diego under Order No. 2003-0005-DWQ.

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[47] An enforcement action is any formal or informal action taken to address an incidence of actual or threatened noncompliance with existing regulations or provisions designed to protect water quality. Potential enforcement actions including notices of violation (NOVs), notices to comply (NTCs), imposition of time schedules (TSO), issuance of cease and desist orders (CDOs) and cleanup and abatement orders (CAOs), administrative civil liability (ACL), and referral to the attorney general (AG) or district attorney (DA). The Regional Board generally implements enforcement through an escalating series of actions to: (1) assist cooperative dischargers in achieving compliance; (2) compel compliance for repeat violations and recalcitrant violators; and (3) provide a disincentive for noncompliance.

[48] The SWRCB administers the awarding of grants funded from Proposition 13, Proposition 50, Clean Water Act 319(h) and other federal appropriations to projects that can result in measurable improvements in water quality, watershed condition, and/or capacity for effective watershed management. Many of these grant fund programs have specific set-asides for expenditures in the areas of watershed management and TMDL project implementation for non-point source pollution.

12. IMPLEMENTATION MONITORING PLAN

This section describes an Implementation Monitoring Plan to assess the success of the implementation action plan presented in section 10 in 1) achieving the copper, lead and zinc wasteload allocations and 2) attaining copper, lead and zinc water quality objectives in Chollas Creek. The plan assigns monitoring responsibilities and describes key milestones.

12.1. Regulatory Authority for Implementation Monitoring Plan

Basin Plans must have a program of implementation to achieve WQOs.[49] The implementation program must include a description of actions that are necessary to achieve WQOs, a time schedule for these actions, and a description of "surveillance" to determine compliance with the water quality objectives.[50] The term "surveillance" in a TMDL context refers to an implementation monitoring plan designed to measure the effectiveness of the TMDL point and nonpoint source control measures and the progress the waterbody is making toward attaining WQOs. Such a plan would necessarily include collection of water quality data. State law requires that a TMDL include an implementation monitoring plan because the TMDL normally is, in essence, an interpretation or refinement of an existing WQO. The TMDL must be incorporated into the Basin Plan,[51] and, because the TMDL supplements, interprets, or refines an existing WQO, State law requires an implementation monitoring plan be included to determine the success of the implementation action plan measures

CWC section 13267 provides that the Regional Board can require any person who has discharged, discharges, proposes to discharge or is suspected of discharging waste to investigate, monitor, and report information. The only restriction is that the burden of preparing the reports bears a reasonable relationship to the need for and the benefits to be obtained from the reports.

CWC section 13383 provides that the Regional Board may establish monitoring requirements for any person who discharges, or proposes to discharge, pollutants to navigable waters of the U.S. Order No. R9-2004-0277, issued by the Regional Board pursuant to section 13383, requires the Municipal Dischargers and CalTrans to conduct an investigation and monitoring program for diazinon, copper, lead, and zinc in Chollas Creek.

[49] See code [CWC section 13050(j)]. A "Water Quality Control Plan" or "Basin Plan" consists of a designation or establishment for the waters within a specified area of all of the following: (1) Beneficial uses to be protected, (2) WQOs and (3) A program of implementation needed for achieving water quality objectives.

[50] See code [CWC section 13242].

[51] See Clean Water Act section 303(e).

12.2. Monitoring Objectives

The specific objectives of this Implementation Monitoring Plan are as follows:

1. Establish a monitoring program for Chollas Creek and its tributaries using monitoring, sampling and analytical methods consistent with the SWRCB Surface Water Ambient Monitoring Program (SWAMP); SWAMP data quality assurance protocols; and SWAMP data management;

2. Characterize baseline conditions in Chollas Creek and its tributaries with respect to metals to place future monitoring data into perspective and document progress towards cleaner water;

3. Track changes in water quality over time in Chollas Creek and its tributaries with respect to metals and enable comparison of baseline data and TMDL project target values with conditions. Determine whether the "trajectory" of the measured water quality values points toward attainment of the copper, lead and zinc WQOs;

4. Evaluate the effectiveness of the TMDL implementation actions over time and determine the need for revisions to improve the implementation action plan;

5. Provide the monitoring data needed to verify or refine assumptions, resolve uncertainties, and improve the scientific foundation of the TMDL. This includes the metals, hardness and flow data necessary to refine land use wash-off models to more accurately estimate copper, lead and zinc mass loads from the Chollas Creek watershed; and

6. Provide the monitoring data needed to evaluate the overall TMDL implementation effectiveness and success in attaining copper, lead and zinc WQOs in Chollas Creek and its tributaries.

12.3. Regional Board Actions

1. **Review Order No. R9-2004-0277, Chollas Creek Investigation Order**
   Order No. R9-2004-0277[52] requires the Municipal Dischargers to implement a monitoring and reporting program for copper, lead, zinc, calcium carbonate and diazinon in Chollas Creek. The Regional Board will review the Order to ensure that all elements of the Implementation Monitoring Plan for this TMDL Project are being addressed in the Order. Furthermore, the Regional Board will research the data requirements to refine the watershed wash-off models to provide more

1.1. [52] Order No. R9-2004-0277, Investigation Order issued to California Department Of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge Of Diazinon into the Chollas Creek Watershed, San Diego, California accurate estimates of the mass loads of copper, lead and zinc leaving the Chollas Creek Watershed on an annual basis. If necessary, Order No. R9-2004-0277 will be amended to include additional monitoring.

2. **Amend Order No. R9-2004-0277, if Necessary, to Require Submission of Revised Monitoring and Reporting Program Plan**
   If the monitoring and reporting program ongoing in Chollas Creek is inadequate to fulfill the monitoring objectives listed is section 12.2, Order R9-2004-0277 shall be amended to require CalTrans and the Municipal Dischargers to prepare and submit a revised Implementation Monitoring and Reporting Program Plan containing the additional elements described in section 12.5 Implementation Monitoring Plan Elements below. CalTrans and the Municipal Dischargers shall be required to implement the revised Implementation Monitoring Plan in accordance with the revised order. The Regional Board may further amend this order at any time.

12.4. Municipal Dischargers and CalTrans Actions

1. **Prepare and Submit Monitoring Plan, if Required**
   The Municipal Dischargers and CalTrans shall collaborate to prepare and submit a revised Implementation Monitoring Plan for the Chollas Creek watershed containing the elements described in section 12.5 Implementation Monitoring Plan Elements below, upon order of the Regional Board pursuant to CWC section 13383. The revised Implementation Monitoring Plan shall be modified as required by the Regional Board.

2. **Implement Monitoring Plan**
   The Municipal Dischargers and CalTrans shall implement the revised Implementation Monitoring Plan upon order of the Regional Board pursuant to CWC section 13383. The Regional Board may amend this order at any time.

12.5. Revised Implementation Monitoring Plan Elements

If required, the revised Implementation Monitoring Plan shall contain the following elements:

1. The data necessary to refine the watershed wash-off models, to provide more accurate estimates of the mass loads of copper, lead and zinc leaving the Chollas Creek Watershed on an annual basis. This is likely to include, at a minimum, measurements of calcium carbonate, copper, lead, zinc and flow during dry weather.

2. Additional wet weather monitoring. The Regional Board is currently working with SCCWRP to identify these data gaps and to begin sample collection as part of the development of the TMDL for metals in San Diego Bay at the mouth of Chollas Creek.

Until Order No. R9-2004-0277 is amended, all monitoring and reporting requirements are in full force and effect. Most, if not all, of the existing requirements will be unchanged if the order is amended.

13. ENVIRONMENTAL REVIEW

This Section presents the Regional Board's environmental analysis of the amendment to the Basin Plan to incorporate TMDLs for Copper, Lead and Zinc in Chollas Creek.

13.1. Legal Requirement for Environmental Review

The Regional Board must comply with the California Environmental Quality Act (CEQA) when the Board amends the Basin Plan.[53] The CEQA process requires the Regional Board to analyze and disclose the potential adverse environmental impacts of a Basin Plan amendment it is initiating or approving. The Regional Board's Basin Plan amendment process must consider alternatives, develop proposals to mitigate or avoid environmental impacts to the extent feasible, and involve the public and other public agencies in the evaluation process.

13.2. Exemption from Requirement to Prepare CEQA Documents

CEQA authorizes the Secretary of the Resources Agency to certify State regulatory programs, designed to meet the goals of CEQA, as exempt from CEQA's requirements to prepare an Environmental Impact Report (EIR), Negative Declaration, or Initial Study. Certified state programs are often referred to as being "functionally equivalent" to the CEQA process.

The Regional Board's Basin Plan amendment process is certified as "functionally equivalent" to the CEQA process and is therefore exempt from CEQA's requirements to prepare an EIR, Negative Declaration, or Initial Study. [54] SWRCB regulations[55] describe the environmental documents required for Basin Plan Amendment actions. These documents are: a written report, an initial draft of the Basin Plan Amendment and an Environmental Checklist Form.[56] This report fulfills the requirements of CEQA for preparation of an environmental document for this Basin Plan amendment.

13.3.Scope of Environmental Analysis

TMDL Basin Plan amendments typically include "performance standards."[57] TMDL projects normally contain a quantifiable numeric target that interprets the applicable

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[53] See Public Resources Code section 21080.

[54] See California Code of Regulations (CCR), Title 14, section 15251(g).

[55] See CCR, Title 23, section 3720 et seq., "Implementation of the Environmental Quality Act of 1970"

[56] See CCR, Title 23, section 3776.

[57] The term "performance standard" is defined in the rulemaking provisions of the Administrative Procedure Act (Government Code sections 11340-l 1359). A "performance standard" is a regulation that describes an objective with the criteria stated for achieving the objective. Government Code section 11342(d)).

water quality objective. TMDL projects also include wasteload allocations for point sources, load allocations for nonpoint sources and natural background. The quantifiable target together with the allocations may be considered a performance standard.

CEQA has specific provisions governing the Regional Board's adoption of regulations such as the regulatory provisions of Basin Plans that establish "performance standards" or treatment requirements.[58] These provisions require that the Regional Board perform an environmental analysis of the reasonably foreseeable methods of compliance with the wasteload and load allocations prior to the adoption of the TMDL Basin Plan amendment. Specifically the Regional Board must provide an environmental analysis including at least the following:

1. A summary of the proposed TMDL Basin Plan amendment. This should include an analysis of issues voiced by the public in the CEQA scoping meeting held during the course of the TMDL Basin Plan development. In this case, no substantive issues were raised during the CEQA scoping meeting;

2. An analysis of the reasonably foreseeable environmental impacts of the implementation methods that may be employed to comply with the TMDL Basin Plan Amendment. The Environmental Checklist Form [23 CCR 3777] should be used to identify any environmental impacts;

3. An analysis of the reasonably foreseeable feasible mitigation measures relating to those environmental impacts; and

4. An analysis of reasonably foreseeable alternatives to the proposed TMDL Basin Plan amendment.

The Regional Board's method of analysis to identify environmental impacts associated with the Chollas Creek TMDL project is based on a "tiering"[59] approach to provide increased efficiency in the CEQA process. Tiering allows the Regional Board to limit its analysis in this document to the broad environmental issues at the Basin Plan amendment "performance standard" adoption stage, which are ripe for decision. The Regional Board is not required, at the Basin Plan amendment adoption stage, to evaluate environmental issues associated with specific projects to be undertaken later to comply with the performance standard.[60] CEQA provisions allow for project level environmental considerations to be deferred so that more detailed examination of the effects of these projects in subsequent second tier CEQA environmental documents can be made by the appropriate lead agency.[61]

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[58] See Public Resources Code (PRC) sections 21159 and 21159.4

[59] See PRC section 21068.5

[60] See PRC sections 21159 through 21159.4 and CCR 14 § 15187. See also the legislative intent in PRC section 21156, and the statutes regarding "tiered" environmental review in PRC sections 21068.5, and 21093-21094.

13.4. Project Description

The purpose of this project is to amend the Basin Plan to incorporate TMDLs for copper, lead, and zinc, and to assign wasteload and load allocations in order to attain and maintain WQOs in Chollas Creek. A wasteload allocation is assigned to point source dischargers and load allocations are assigned to nonpoint sources land use activities to reduce metals loading to Chollas Creek. The most significant sources of copper, lead and zinc to Chollas Creek are point sources under the jurisdiction of several NPDES Orders. Each of the point source dischargers named in sections 11.0 and 12.0 of this Technical Report will be required to meet the WLA of this TMDL project.

The Basin Plan amendment contains an Implementation Action Plan describing:

1. Actions that are specific to the pollutant and waterbody for which the TMDLs are being established;

2. Persons responsible for implementing specified control actions;

3. A timeline description of when activities necessary to implement the TMDL will occur;

4. A description of the legal authorities under which implementation will occur;

5. A description of milestones that will be used to measure progress; and

6. The time required for attaining water quality objectives.

The Basin Plan amendment also contains an Implementation Monitoring Plan to evaluate the overall TMDL implementation effectiveness and success in attaining metals WQOs in Chollas Creek and its tributaries.

13.5. Analysis of Reasonably Foreseeable Environmental Impacts

This section identifies a range of reasonably foreseeable methods of compliance with the Basin Plan amendment and describes the environmental impacts of those methods.

13.5.1 Reasonably Foreseeable Compliance Methods

The majority of metals discharged into the Chollas Creek watershed result from stormwater runoff of metals from freeway surfaces and commercial/industrial land uses. Attainment of the WLAs will be achieved through discharger implementation of structural and nonstructural BMPs control strategies designed to reduce metals loading. Structural and non-structural control strategies can be based on specific land uses, sources, or periods of a storm event, and are described in general below. Nonstructural

[61] See PRC section 21067. "Lead Agency" is the public agency that has the principal responsibility for carrying out or approving a project. The Lead Agency will decide whether an EIR or Negative Declaration will be required for the project, and will cause the document to be prepared.

BMPs are generally designed to control or eliminate the sources of pollutants to a watershed. Structural BMPs include source control as well as treatment control BMPs designed to remove pollutants from runoff.[62] In order to comply with this TMDL project, emphasis should be placed on BMPs that control the sources of pollutants and on the maintenance of BMPs that remove pollutants from runoff. Some examples of BMPs that may be implemented by the dischargers to meet the WLAs are described in general below.

Nonstructural Controls

1. **Education and Outreach**: Conduct education and outreach to residents and businesses to discourage over-watering. Conduct education and outreach to residents, businesses and municipal fleets to encourage vehicle and equipment practices that minimize the potential for contamination of stormwater runoff.

2. **Road and Street Maintenance**: Increase the frequency of street sweeping to maintain clean sidewalks, streets, and gutters. Street sweeping reduces non-point source pollution by five to 30 percent when a conventional mechanical broom and vacuum-assisted wet sweeper is used.[63] USEPA reports that the new vacuum assisted dry sweepers can achieve a 50 to 88 percent overall reduction in the annual sediment loading for a residential street, depending on sweeping frequency. A reduction in sediment load may lead to a reduction in metals being carried to the MS4, and ultimately to Chollas Creek, since sediment, or road dust, has been found to adsorb metals (Birch and Scollen, 2003). Researchers have found that the metals concentrations in road dust increases with traffic volume. High traffic areas should be given a priority when scheduling street sweepings.

3. **Illicit Discharges**: Identify and eliminate illicit discharges to the storm drain system.

4. **Inspections**: Conduct inspections of commercial and industrial facilities for compliance with local ordinances and permits, as well as copper, lead and zinc load reductions required under this TMDL. Conduct inspections of treatment control BMPs to ensure their adequacy of design and proper function.

Structural Controls

1. **Vegetated Swales and Buffer Strips**: Construct and maintain vegetative buffer strips along roadsides and in medians to slow runoff velocities and increase stormwater infiltration. Replace curbs with vegetated swales to allow highway and road runoff to be filtered through vegetated shoulders and medians. Eliminate constructed curbs to increases infiltration to ground water.

[62] California Stormwater Quality Association. 2003. Stormwater BMP Handbook. Municipal. January 2003.

[63] [USEPA, 1999, National Menu of Best Management Practices for Stormwater-Phase II, *http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_4.cfm*]

2. **Bioretention**: Construct and maintain bioretention BMPs to provide on-site removal of metals from storm water runoff through landscaping features.[64] Field and laboratory analysis of bio-retention facilities shows high removal rates of copper (43 to 97 percent), lead (70 to 95 percent), and zinc (64 to 95 percent).

3. **Detention Basins**: Construct and maintain detention basins designed to capture and treat stormwater runoff.

4. **Retention Ponds**: Construct and maintain retention/irrigation ponds to capture stormwater runoff for later irrigation of landscape.

5. **Sand Filters:** Install and maintain sand filters, which are effective for pollutant removal from stormwater. Sand filters may be a good option in densely developed urban areas with little pervious surface since the filters occupy minimal space.

6. **Diversion Systems**: Install diversion systems to capture non-stormwater runoff. During low flow conditions, runoff may be diverted to an on-site treatment system and released back to the creek, or it may be diverted to wastewater collection plants for treatment.

13.6. Environmental Impacts of Reasonably Foreseeable Compliance Methods

The environmental checklist, found in Appendix I, describes the potential for environmental impacts associated with the reasonably foreseeable compliance methods discussed above. The environmental checklist indicates that the TMDL Basin Plan amendment will not have any direct adverse environmental impacts. The implementation of this TMDL project will in effect lead to an overall improvement in the quality of water and therefore the quality of the environment.

The environmental checklist indicated potential, or indirect, environmental impacts could arise from treatment control BMP projects that could be implemented to comply with the Chollas Creek TMDL project. However, identifying the specific projects that the dischargers might implement is overly speculative at this time. The precise nature, location, and significance of the environmental impacts of possible projects cannot be determined at this time, since the TMDL implementation action plan establishes a process for identifying subsequent BMP projects rather than specifying particular projects at specific locations. Future CEQA documents prepared for specific BMP implementation projects will identify site-specific environmental impacts and the need for feasible mitigation measures. This CEQA Checklist (Appendix I) identifies the environmental impacts associated with treatment control BMPs in general and proposed appropriate mitigation measures are discussed below.

[64] ibid

BMPs implemented by the dischargers could have a potentially significant impact on the environment unless mitigation is incorporated into the BMP with respect to riparian habitat or other sensitive natural communities. Adverse environmental impacts are more often associated with treatment control BMPs rather than source control BMPs. Examples of potential impacts and mitigation associated with treatment control BMPs that might be implemented are discussed below.

In order to remove metals during dry weather, diversion systems may be put into place in Chollas Creek. While the use of diversion systems during dry weather may result in decreased metal concentrations in the creek, the removal of water from the creek could alter the hydrology of the stream and result in adverse impacts to aquatic life dependent on the stream. Mitigation to lessen any such impacts may involve diverting only a portion of the water from the creek sufficient to remove metals but not to significantly alter the creek's hydrology. An additional mitigation measure could involve returning treated water to the stream.

Another potential adverse impact resulting from the use of diversion systems involves the potential for entrainment of fauna and flora from the creek. As a mitigation measure to avoid entraining flora and fauna, diversion systems may be set up that divert flow "in-pipe," (i.e. in the storm drain), rather than in the creek. Furthermore, screens may be put into place to help prevent the uptake of aquatic organisms. Diversion systems should be properly maintained to ensure that they function appropriately and do not result in adverse environmental impacts.

Potential adverse impacts may also result from the use of treatment control BMPs that increase the likelihood of vectors and pests. For example, constructed basins and vegetated swales may develop locations of pooled standing water that would increase the likelihood of mosquito breeding. Mitigation may involve the prevention of standing water through the construction and maintenance of appropriate drainage slopes and through the use of aeration pumps.[65] Mitigation for vectors and pests should involve the use of appropriate vector and pest control strategies and maintenance such as frequent inspections to prevent adverse environmental impacts.

Certain types of treatment control BMPs such as infiltration trenches and infiltration basins may result in the accumulation of metals to potentially hazardous levels. The accumulation of metals in turn could lead to contamination of groundwater. Mitigation may involve regular inspections, monitoring, and maintenance including disposal of waste at appropriate landfills when necessary.

Another potential adverse environmental impact could result from the introduction and/or establishment of invasive species in wet ponds and bioretention BMPs. Vegetation should be chosen to help reduce or eliminate this possibility, and the BMPs should be maintained and inspected routinely to identify the establishment of any potentially invasive species.

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[65] *http://www.cabmphandbooks.com/Municipal.asp*

In conclusion, implementation measures should be chosen to reduce metals loading to Chollas Creek. Efforts should first be aimed at source control and then at treatment control since treatment control BMPs have greater potential for adverse environmental impacts. Appropriate mitigation including frequent inspections and maintenance should be incorporated to reduce or eliminate any adverse environmental impacts.

13.7. Reasonable Alternatives to the TMDL Basin Plan Amendment

This section describes the Regional Board's analysis of reasonable alternatives to the proposed project. The purpose of this analysis is to determine if the alternatives would feasibly attain the basic objective of the TMDL Basin Plan amendment but would avoid or substantially lessen any potential significant effects of the proposed amendment. The four alternatives include taking "no action", using a regulatory approach to TMDL implementation, and deferring adoption of the TMDLs until either site-specific water quality objectives are developed or new metals criteria are established.

13.8. No Action Alternative

Under the "no action" alternative, the Regional Board would not adopt the proposed TMDL Basin Plan amendment, and metals loading would likely continue at current levels. The no action alternative 1) does not comply with the CWA; 2) is inconsistent with the mission of the Regional Board; and 3) does not meet the purpose of the proposed TMDL Basin Plan Amendment. Under CWA section 303(d), the Regional Board is obligated to adopt a TMDL project for waters such as Chollas Creek that do not meet WQSs.[66] The mission of the Regional Board is to ensure the protection of receiving water beneficial uses through attainment of applicable WQOs. Consistent with the Regional Board's mission, the purpose of the proposed TMDL Basin Plan Amendment is to attain WQOs for copper, lead and zinc, and to restore and protect the wildlife and aquatic habitat beneficial uses of Chollas Creek.

Ultimately, the USEPA is required to develop and adopt TMDLs pursuant to CWA section 303(d) if the State does not adopt a proposed TMDL and implementation plan.

13.9. Develop Site-Specific Metals Water Quality Objectives

It may be appropriate to develop Site-Specific Objectives (SSOs) for copper, lead and/or zinc in Chollas Creek. If scientific studies demonstrate that the ambient water chemistry and/or biological communities at Chollas Creek are significantly different from the chemistry and biological communities upon which the current limits are based, SSOs for metals may be appropriate. SSOs should be (1) based on sound scientific rationale; (2) protect the designated beneficial uses of Chollas Creek waters; and (3) be adopted by the Regional Board in a Basin Plan amendment.

[66] WQSs are comprised of designated beneficial uses, the applicable numeric and/or narrative WQOs to protect those uses, and the SWRCB's anti-degradation policy provisions (Resolution No. 68-16, Statement of Policy with Respect to Maintaining High Quality of Waters in California).

There are no efforts currently underway or planned by interested persons to fund the scientific studies needed to develop SSOs for metals in Chollas Creek. Furthermore, the development of SSOs for metals in Chollas Creek, including the scientific studies necessary to support them, would be costly, time consuming, and resource intensive. Dischargers or other interested parties would need to fund and initiate the scientific studies to develop the SSOs.

Even in the event that scientific studies were initiated and SSOs developed and adopted by the Regional Board, it would likely not obviate the need for a TMDL. Accordingly, the appropriate strategy for addressing the water quality problems in Chollas Creek is for the Regional Board to proceed with adoption of the proposed TMDL Basin Plan amendment at this time. If SSOs for metals were developed in the future and adopted by the Regional Board, this TMDL Basin Plan Amendment would be modified accordingly. If interested parties were willing to fund and oversee development of scientific studies to investigate SSOs, the most effective and expeditious means to improve water quality would be to conduct these studies concurrent with actions necessary to achieve compliance with the current TMDL.

14. ECONOMIC ANALYSIS

This section presents the Regional Board's economic analysis of the most reasonably foreseeable methods of compliance with the Basin Plan amendment to incorporate TMDLs for metals in Chollas Creek.

14.1. Legal Requirement for Economic Analysis

The Regional Board must comply with CEQA when amending the Basin Plan.[67] The CEQA process requires the Regional Board to analyze and disclose the potential adverse environmental impacts of a Basin Plan amendment that is being considered for approving. TMDL Basin Plan amendments typically include "performance standards."[68] TMDLs normally contain a quantifiable numeric target that interprets the applicable WQO. TMDLs also include WLAs for point sources and LAs for both nonpoint sources and natural background. The quantifiable target together with the allocations may be considered a performance standard.

CEQA has specific provisions governing the Regional Board's adoption of regulations such as the regulatory provisions of Basin Plans that establish "performance standards" or treatment requirements.[69] These provisions require that the Regional Board perform an environmental analysis of the reasonably foreseeable methods of compliance with the WLAs and LAs prior to the adoption of the TMDL Basin Plan amendment. The Regional Board must consider the economic costs of the methods of compliance in this analysis.[70] The proposed Basin Plan amendment does not include new WQOs but implements existing objectives to protect beneficial uses. The Regional Board is therefore not required to do a formal cost-benefit analysis.

14.2. TMDL Project Implementation Costs

The most reasonably foreseeable method of compliance with this Basin Plan amendment establishing TMDL projects involves reducing copper, lead, and zinc loads to surface waters by implementing BMPs. Investigation Order No. R9-2004-0227[71] already includes a monitoring and reporting program for metals in Chollas Creek. Whether or not an expansion of this program will be necessary is not known at this time, but will be evaluated by the Regional Board following adoption of this TMDL project. The monitoring and reporting costs are not disclosed in this report since monitoring and reporting is a requirement of the existing Order and the need for additional monitoring is

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[67] PRC Section 21080

[68] The term "performance standard" is defined in the rulemaking provisions of the Administrative Procedure Act (Government Code sections 11340-l 1359). A "performance standard" is a regulation that describes an objective with the criteria stated for achieving the objective. [Government Code §11342(d)].

[69] PRC sections 21159 and 21159.4

[70] See PRC section 21159(c)

[71] Investigative Order No. R9-2004-0227 [W.C. 13383], *California Department of Transportation and San Diego Municipal Separate Storm Sewer System Copermittees Responsible for the Discharge of Diazinon into the Chollas Creek Watershed, San Diego, California*

unknown at this time. This economic analysis discloses the costs of implementing typical stormwater BMPs for reduction of metals.

The specific BMPs to be implemented will be chosen by the dischargers after adoption of this TMDL project. All costs are preliminary estimates only, since particular elements of a BMP, such as type, size, and location, would need to be developed to provide a basis for more accurate cost estimations. Identifying the specific BMPs that dischargers will choose to implement is speculative at this time. Therefore, this section discloses typical costs of conventional stormwater BMPs, as discussed above.

14.3. Cost Estimates of Typical BMPs for Stormwater and Non-stormwater Discharges

Approximate costs associated with typical non-structural and structural BMPs that might be implemented in order to comply with the requirements of this TMDL project are provided below. The BMPs are divided into non-structural and structural classes. Some BMPs may already be implemented in Chollas Creek in compliance with Order No. 2001-0001 requirements described in section 11.0 Implementation Action Plan.

Non-Structural BMPs
Education and Outreach: Education and outreach to residents, businesses and industries can be a very effective tool. These efforts might be focused on the reduction of metal releases from the activities associated with the normal operation of automobiles. The cost of producing educational materials will vary with the scope of efforts and are estimated to be between \$100 to \$10,000.[72] Because education and outreach is a component of Order No. 2001-0001 regulating stormwater discharges, costs to develop and conduct outreach and educational programs to comply with the TMDL project requirements are expected to be minimal.

Road and Street Maintenance: Another effective BMP to prevent pollutants from entering the MS4 is to maintain clean sidewalks, streets, and gutters. The largest expenditures for street sweeping programs are in staffing and equipment. The capital cost for a street sweeper is between \$60,000 and \$180,000 and the average useful life of a sweeper is about four to eight years.[73] Increased street sweeping could lead to faster wear and tear of the road surface, which would add additional costs for road repair work. This particular BMP may prove to be more cost-effective than certain structural controls, especially in more urbanized areas with greater areas of pavement.

Illicit Discharges: Illicit discharges to the stormwater system can be identified through visual inspections during dry weather or through the use of smoke or dye tests. The costs of smoke and dye tests vary from \$1,250 to \$1,750. The overall costs associated with compliance of the TMDL project are expected to be relatively minor since the

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[72] USEPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012. August 1999].
[73] Ibid.

identification of illicit discharges is an important component of compliance with Order No. 2001-0001 regulating stormwater discharges.

Inspections: The costs associated with inspections include staffing, travel and administrative costs. The costs to comply with the TMDL project requirements are expected to be relatively minor since inspections are an important component of compliance with Order No. 2001-0001and the CalTrans statewide MS4 Order.

Structural BMPs

Vegetated Swales and Buffer Strips: The costs associated with vegetated swales and vegetated buffer strips vary and are dependent of the costs associated with establishing the vegetation.[74] Cost estimates range from $3,500 for vegetated swales, to $0 to $9,000 for buffer strips.[75]

Bioretention: Bioretention areas are landscaping features adapted to provide on-site treatment of storm water runoff (USEPA, 1999, National Menu of Best Management Practices for Stormwater-Phase II).[76] Field and laboratory analysis of bioretention facilities show high removal rates of copper (43 to 97 percent), lead (70 to 95 percent), and zinc (64 to 95 percent). Bioretention facilities are relatively expensive. USEPA reported the following cost equation to estimate this storm water management practice, adjusting for inflation:

$$\mathbf{C = 7.30\ V^{0.99}}$$

where:

C = Construction, design, and permitting cost ($); and

V = Volume of water treated by the facility (ft^3).

Consideration should be made when evaluating the costs of bioretention that the practice replaces areas that most likely would have been landscaped. The true cost of the practice is therefore less than the construction cost reported. Maintenance activities conducted on bioretention facilities were also not found to be very different from maintenance of a landscaped area. The estimated cost of bioretention for a 5-acre commercial site is $60,0000.[77]

Detention Basins and Retention Ponds: The costs vary depending on the volume of the basin. Costs for retention and detention basins are estimated at approximately $100,0000 for a 50-acre residential site.[78]

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[74] Ibid
[75] Ibid.
[76] http://cfpub.epa.gov/npdes/stormwater/menuofbmps/post_4.cfm
[77] USEPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. [EPA-821-R-99-012]. August 1999.
[78] Ibid.

Sand Filters: USEPA reported that the typical cost of installation of sand filters ranges between $2.50 and $7.50 per cubic foot of storm water treated, with an average cost of about $5 per cubic foot (USEPA, 1999). The cost per impervious acre treated varies considerably depending on the region and design used. The observed volume of stormwater in the Chollas Creek watershed from Table F-4 in Appendix F of this report for the 2001 through 2003 storm years[79] is 1,646,496,115 liters. Dividing this number by two gives an average of 29,072,731 cubic feet of storm water per year. Therefore, the maximum cost of using sand filters to treat all Chollas Creek stormwater could range from approximately $70 to $220 million. The average expected costs would be $145 million.

Diversion Systems: If no other on-site treatment options are available, diverting the polluted runoff to the sanitary sewer systems treatment plant may be considered. An individual diversion structure was estimated to cost about one million dollars, which does not include maintenance costs. The maintenance costs could be significant due to the need for regular inspections and maintenance of the diversion structures (Ruth Kolb, City of San Diego, personal communication, March 14, 2005).

14.4. Cost Estimate Summary

Table 14.1summarizes the estimated costs for the specific BMPs that were evaluated.

TABLE 14.1 Summary of cost estimates for available BMPs

BMP	***Estimated Cost****
Non-Structural BMPs	
Education and Outreach	$100 - $10,000 per program
Street Sweeping	$ 60,000 - $180,000 per unit
Illicit Discharges	$0 to $1,750
Inspections	Insignificant
Structural BMPs	
Vegetated Swale	$3,500
Vegetated Buffer Strip	$0 - $9,000
Bioretention	$60,000 for a 5-acre commercial site
Detention Basins and Retention Ponds	$100,0000 for a 50-acre residential site
Sand Filters	$70 to $220 million
Diversion	$1 million per unit

*The cost of these BMPs was obtained from USEPA. 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices. (EPA-821-R-99-012). August 1999.

[79] These estimates come from only two years of storm flow observations. These years may or may not represent the average flow volume experienced in Chollas Creek.

15. NECESSITY OF REGULATORY PROVISIONS

The OAL is responsible for reviewing administrative regulations proposed by State agencies for compliance with standards set forth in California's Administrative Procedure Act, Government Code section 11340 et seq., for transmitting these regulations to the Secretary of State and for publishing regulations in the California Code of Regulations (CCR). Following SWRCB approval of this Basin Plan amendment establishing TMDLs, any regulatory portions of the amendment must be approved by OAL per Government Code section 11352. The SWRCB must include in its submittal to OAL a summary of the necessity[80] for the regulatory provision.

This Basin Plan amendment for Chollas Creek meets the "necessity standard" of Government Code section 11353(b). Amendment of the Basin Plan to establish and implement copper, lead and zinc TMDLs in Chollas Creek is necessary because the existing water quality does not meet applicable numeric WQOs for these metals. Applicable state and federal laws require the adoption of this Basin Plan amendment and regulations as provided below.

The SWRCB and Regional Boards are delegated the responsibility for implementing California's Porter Cologne Water Quality Control Act and the federal CWA. Pursuant to relevant provisions of both of those acts the SWRCB and Regional Boards establish WQSs, including designated (beneficial) uses and criteria or objectives to protect those uses.

Section 303(d) of the CWA [33 USC section 1313(d)] requires the states to identify certain waters within their borders that are not attaining WQSs and to establish TMDLs for certain pollutants impairing those waters. USEPA regulations in Title 40 of the CFR section 130.2 provide that a TMDL is a numerical calculation of the amount of a pollutant that a water body can assimilate and still meet standards. A TMDL includes one or more numeric targets that represent attainment of the applicable standards, considering seasonal variations and a MOS, in addition to the allocation of the target or load among the various sources of the pollutant. These include WLAs for point sources, and LAs for nonpoint sources and natural background. TMDLs established for impaired waters must be submitted to the USEPA for approval.

CWA section 303(e) requires that TMDLs, upon USEPA approval, be incorporated into the state's Water Quality Management Plans. In California, these are the Basin Plans for the nine regions. CWC sections 13050(j) and 13242 require that Basin Plans have a program of implementation to achieve WQOs. The implementation program must include a description of actions that are necessary to achieve the objectives, a time schedule for these actions, and a description of surveillance to determine compliance with

[80] "Necessity" means the record of the rulemaking proceeding demonstrates by substantial evidence the need for a regulation to effectuate the purpose of the statute, court decision, provision of law that the regulation implements, interprets, or makes, taking into account the totality of the record. For purposes of this standard, evidence includes, but is not limited to, facts, studies, and expert opinion. [Government Code section 11349(a)].

the objectives. State law requires that a TMDL project include an implementation plan because TMDLs normally are, in essence, interpretations or refinements of existing WQOs. The TMDLs have to be incorporated into the Basin Plan [CWA section 303(e)], and, because the TMDLs supplement, interpret, or refine existing objectives, State law requires a program of implementation.

16. PUBLIC PARTICIPATION

Public participation is an important component of TMDL development. The federal regulations [40 CFR 130.7] require that TMDL projects be subject to public review. All public hearings and public meetings have been conducted as stipulated in the regulations [40 CFR 25.5 and 40 CFR 25.6, respectively], for all programs under the CWA. Public participation was provided through four public workshops, numerous stakeholder group meetings and communications, and public presentations and participation at relevant conferences. In addition, staff contact information was provided on the Regional Board's web site, along with periodically updated drafts of TMDL project documents throughout the development process. Public participation will also occur through the Regional Board's Basin Plan amendment process, which includes a public workshop and formal public comment period. A chronology of public participation and major milestones is provided in Table X.1 below:

Table 16.1. Public Participation Milestones

Date	**Event**
May 2000–Ongoing	Web Site – Information including drafts of the technical report and contact information were made available on the Regional Board's web site.
August 1999	Public Workshop
December 1999	Public Workshop
May 2000	Public Workshop
March 2003	Public Workshop and CEQA Scoping Meeting
March 17, 2005	Informal Public Review
March 28, 2005	Release draft for formal Public Review
April 28, 2005 *tentatively scheduled*	Public Workshop
May 11, 2005 *tentatively scheduled*	Public Hearing

17. REFERENCES

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